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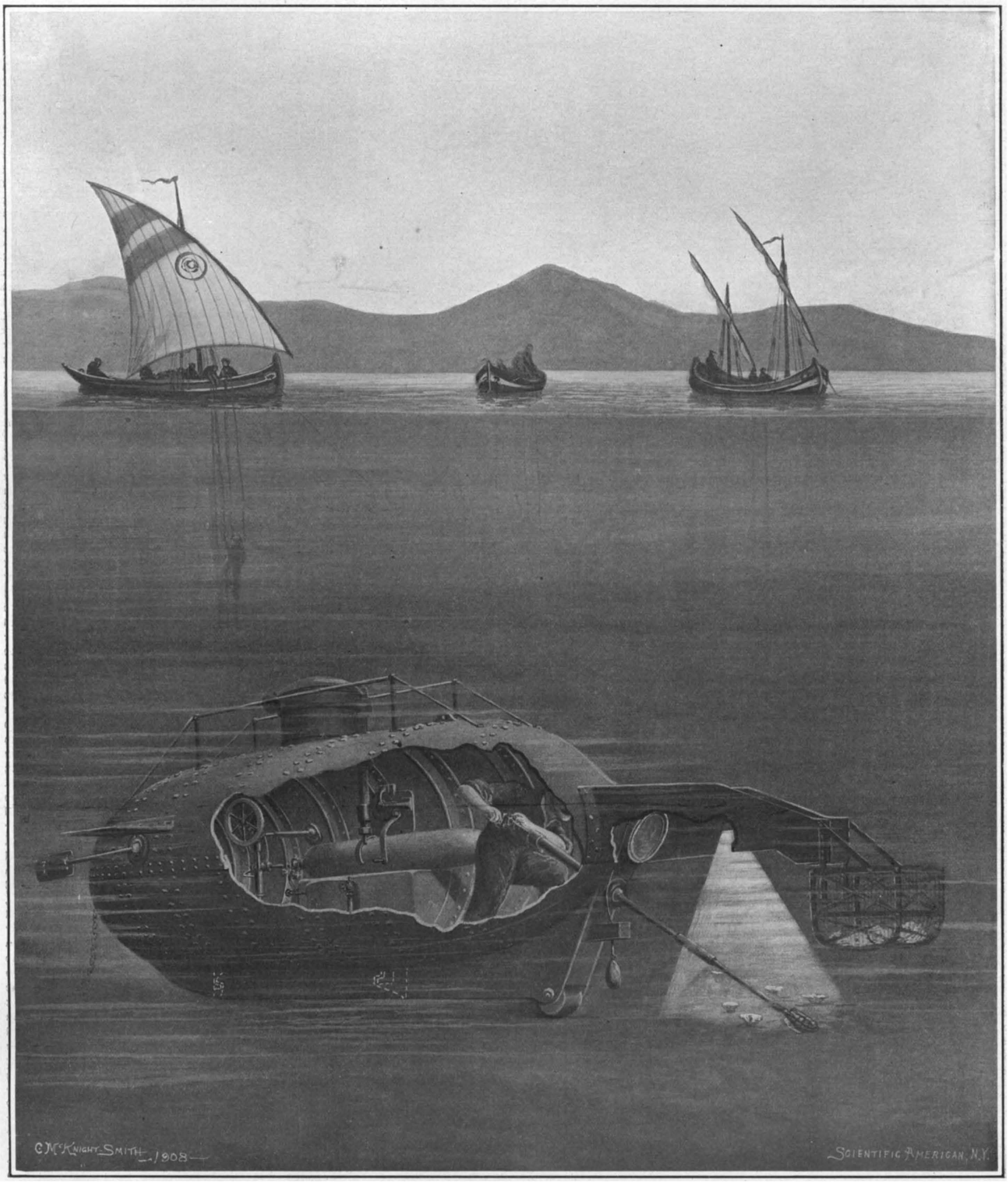
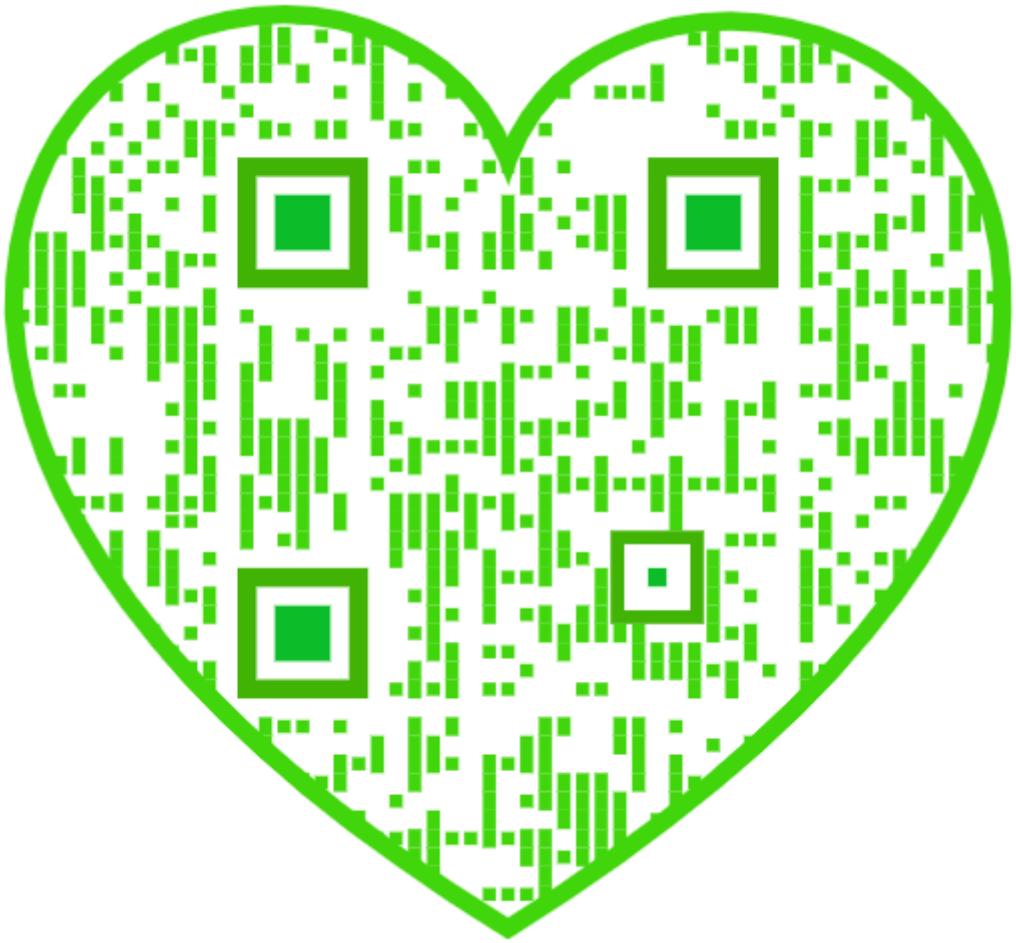



**Projecting Through the Bow of the Boat is an Arm Fitted With Means for Cutting the Sponges Loose and Depositing Them Into an Iron Basket Suspended from the Bowsprit.**

**A SUBMARINE BOAT FOR SPONGE FISHING.**—[See page 330]



# SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MAY 9, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## CRITICISM OF CATSKILL WATER SUPPLY SCHEME.

Based upon the fact that during the winter months all the reservoirs of the Catskill watershed have been full, and that since November there has been an overflow at the spillway of the Croton Dam of water for which there was no storage capacity, a certain amount of unjustifiable criticism has been directed against the Catskill Water Supply scheme. It has been urged that the present plans, which call for an expenditure of $161,000,000, are a needless extravagance, since the additional amount of water necessary to meet the increasing needs of the city could be secured by building more reservoirs in the Croton watershed.

In reply to this criticism the Board of Water Supply has made a statement, which clearly demonstrates that the Croton district cannot possibly meet the needs of the city in the future, and that it is necessary to go to the Catskills for an adequate supply. The facts are that the daily consumption of Croton water amounted last year to 324,000,000 gallons; and that the average daily consumption estimated by the growth of population is increasing at the rate of 15,000,000 gallons a year; and it is evident that at this rate the daily consumption will have risen by the year 1910 to 369,000,000 gallons. Now, the natural daily flow of water in the Croton River averaged for the eighteen years from 1879 to 1897 only 348,000,000 gallons, and from this 10,000,000 gallons per day should be deducted for evaporation.

Furthermore, in order to prevent any water whatever going to waste, it would be necessary to build additional reservoirs to hold 305,000,000,000 gallons above what is now provided for in the nine existing storage reservoirs. Even if this vast system were built, it would increase the average daily supply by only about 47,000,000 gallons. It would take twelve years to construct, and would cost about $150,000,000 for reservoirs alone. This should be compared with the Catskill water supply, which, instead of 47,000,000 gallons daily, will supply about 600,000,000 gallons at a cost of $161,000,000. Moreover, above half of this sum will be expended on filters, distribution reservoirs, conduits to Brooklyn and Staten Island, and for the enlargement of Kensico into a great storage reservoir capable of supplying the city's needs for two months.

## COAL CONSUMPTION OF THE "LUSITANIA."

At the last meeting of the Institution of Naval Architects a paper was presented by Mr. Thomas Bell on the speed of the "Lusitania," which made public, for the first time, the facts concerning that much-discussed matter, the coal consumption of the new turbine liners. In view of the great secrecy which has been maintained by the builders and owners of recent turbine-driven ships, and particularly those of large horse-power, it is decidedly gratifying to have, not only the matter of coal consumption, but also all the principal data of the performance of one of these ships, published for the benefit of the profession. Among the various tables given in the paper, the most valuable is the abstract of the engine room log for the third voyage west from Queenstown to New York, which commenced at noon, November 3 last, and finished off Sandy Hook at 1:14 A. M. on November 8. The total distance run was 2,781 knots; the time, 4 days, 18 hours, and 40 minutes; the longest day's run 618 miles, and the average speed of the whole voyage, 24.25 knots. The average daily coal consumption for the four complete days of about twenty-five hours each was 1,090 tons. Just here it is interesting to note how exact is the art of designing fast steamships, as shown by the fact that the estimated coal consumption when the designs were drawn up, was 1,100 tons average per day. The total bunker capacity of the "Lusitania" is 6,200 tons, or sufficient, at this rate of coal consumption, to carry the ship 500 miles farther than the distance from Queenstown to Sandy Hook. On the voyage referred to, the actual amount of coal consumed for the engines was 4,976 tons, while 18 tons was consumed in the galleys, etc. It should be noted that the mean draft of the ship was about 32 feet, and her displacement about 36,000 tons. The weather throughout the trip is described as having been the average mid-Atlantic winter weather, with strong winds and boisterous sea. During the first half of the voyage the mean speed was 24.65 knots; but a furious southwesterly gale served to reduce the speed for the last twenty-four hours below 23 knots, and to bring down the mean average of the whole trip to 24.25 knots.

Of great interest, also, are the figures offered by Mr. Bell of the data secured on the 1,200-mile trial. The horse-power, as determined by the shaft torsimeter, was 68,850, giving an average speed of 25.4 knots. The total consumption of steam in the turbines in pounds per hour was 879,500, and the total consumption of the auxiliaries was 116,500 pounds per hour. The steam consumption of the turbines in pounds per horse-power hour was 12.77, and the total steam consumption for all purposes was 14.46 pounds per horse-power hour. The coal consumption per horse-power hour worked out at 1.43, including, of course, the auxiliaries. Now, this consumption is about the same as that of the high-speed German liners, using multiple-expansion reciprocating engines, Howden's forced draft, and other modern refinements. Mr. Bell and those responsible for the Cunard ships are to be congratulated on having published these data, and thereby set at rest the absurd rumors, to the effect that the coal-consumption on these big ships was so great that they had, at times, difficulty in making port. During the discussion of the paper, the builders both of the "Mauretania" and "Lusitania" expressed their confidence that when the working staff had become thoroughly conversant with the ships, speeds equal to those obtained on trial would be realized, under favorable weather conditions, on the Atlantic passage. In this connection, it is interesting to note that on trial the "Lusitania" averaged 25.4 knots, and the "Mauretania" 26.04 knots over a course of 1,200 knots.

## SPRAYING ROADS WITH TAR.

From the engineer of the city of Bristol, England, comes a strong indorsement of tar-spraying as a means of keeping down the dust and reducing the cost of maintenance of highways. In view of the steady increase in the number of automobiles, of which there is at present no sign of any abatement, the question of oiling or tarring roads is of paramount importance. In the recent experiments in England it was fo nd that the best results were achieved when the roads were in good condition and the surface had been worn to a compact, smooth face.

The city engineer reports that the tar, after spraying, penetrated to a depth of half an inch and formed a watertight skin, which shed the newly-fallen rain rapidly, and speedily dried when a storm was over. An immediate result was that the amount of labor required to clean the roads was greatly reduced. For purposes of comparison, the tar on several roads was laid on by hand; but it was found that the results were not so satisfactory as when the tar was forced against the surface in the form of a fine spray. All the reports made to the engineer were unanimous in stating that the tar process had effected a considerable saving on the cost of repairs. Thus, on one stretch of road, which would ordinarily have required this year a new coating of broken stone, it was found that where the surface was broken, a few patchings, sprayed with tar, proved to be sufficient repairs. In the case of another section, treated in 1907, the surface is this year "as good as ever." Ordinarily, a new coating of stone would have been necessary on this road in 1909; but it is considered that if the tar-spraying is continued, no repairs will be required before 1910, in which case there will have been a saving in cost of maintenance and repairs of fifty per cent. Particular note should be taken of the fact that, after the application of the tar, the roads so treated required no watering, before the road was swept, beyond a slight sprinkling in front of stores and other buildings. Adjoining roads, on the other hand, which had not been tar-sprayed, had to be watered on eighty-nine days of the year.

## PHENOMENAL SPEED OF LATEST TORPEDOES.

It is not many years since torpedo-boat destroyers were confronted with the dilemma that they were faster than the torpedo which they discharged, and that, consequently, if they fired a torpedo through the bow tube, they were liable to overtake it and be "hoist with their own petard." As matters now stand in the British navy, for instance, the latest type of torpedo can run at a speed of 35 knots at a range of 1,000 yards, and of 30 knots at a range of 1,500 yards; but the latest destroyers of the "Tribal" class, which recently showed a maximum speed on trial of from 33 to 36 knots, would run down their own weapons within a few minutes' time after firing them. The danger of overrunning led, a few years ago, to the abandonment of bow-discharge tubes. The change was made with great reluctance, for the reason that there are decided advantages in attacking the enemy bow-on, the destroyer presenting a small target and being able, by reversing its engines, to back quickly away. The problem has recently been solved both in this country and in England, by the introduction of a very simple and highly efficient device into the torpedo, which has so greatly increased its speed, that the danger of overrunning has been eliminated. The first work in this direction was done by the Bliss-Leavitt Company in the United States, who introduced a method of heating the compressed air with which the torpedoes are driven, and so increasing its energy that the speed of the torpedo is raised several knots an hour. Work along the same lines has been done by the Whitehead Company in England, by which even more remarkable speeds have been obtained, the 18-inch torpedo having a speed of 43 knots an hour for 1,000 yards. It is claimed that by burning liquid fuel in a chamber through which the air passes on its way from the reservoir to the torpedo engine, there is a gain of power of fully 100 per cent. The additional parts occupy only about 3 inches of the length of the torpedo, and weigh only about 12 pounds. The advantage gained by the introduction of heat is shown in the following comparison of results obtained with the latest Whitehead torpedo, when it is run without and with the heater: At 4,000 yards range the speed, using cold air, is from 18 to 20 knots, and using hot air is 28 knots. At 2,000 yards the application of hot air raises the speed from 28¼ knots to 38 knots, and at 1,000 yards range the speed is increased from 35 knots with cold air to 43 knots with the heater in use.

## GERMANY'S GREAT ARMORED CRUISER.

Germany is even more successful than Japan in maintaining secrecy about the new ships building for her navy. This is true of their first "Dreadnought," which was launched a few weeks ago and will be known as the "Nassau," about whose armament there is even yet considerable mystification on the part of the public; for although this ship has generally been credited with a battery of sixteen 11-inch guns, we think it is quite possible that she will be found to carry only ten of these weapons, or the same number of big pieces as are carried by the British "Dreadnought" and by our "North Dakota."

The new cruiser, which was laid down last June at the Weser yard, Bremen, and is known at present only by its official designation of armored cruiser "F," according to present indications will be the largest armored cruiser afloat. The latest advices give her displacement as 19,000 tons, or nearly 2,000 more than that of the British "Inflexible." She is to be protected by an armor belt 8 inches in thickness amidships, which is one inch more than has been placed at the waterline of the British cruiser. In her outboard profile she will show a long and lofty spar deck, extending from the stem aft for two-thirds of the ship's length, with a freeboard of about 28 feet. Forward on this deck will be a turret mounting two 11-inch 50-caliber guns. Immediately astern and mounted on the superstructure deck will be another pair of 11-inch guns in a twin turret. About 50 feet aft, and mounted one on either beam on the spar deck, will be two wing turrets, each carrying a pair of 11-inch guns. On the after end of the spar deck on the axial line of the ship will be the fifth turret with two 11's, and immediately below this on the quarter deck will be the sixth turret with its pair of 11-inch guns. By this arrangement she will be able to concentrate a fire dead ahead and dead astern of eight 11-inch; while on either broadside the new cruiser will deliver the fire of ten 11-inch guns. As compared with this, the British "Dreadnought" can concentrate the fire of six 12-inch ahead or astern and eight 12-inch on each broadside. Compared in respect of weight of metal thrown, the "Inflexible" could fire 6,800 pounds on either broadside as against 7,600 pounds thrown by cruiser "F," and 5,100 pounds ahead or astern as against 6,080 pounds thrown by the German ship. The "Invincible" is to show a speed of 25 knots with 41,000 turbine horse-power on trial. Cruiser "F" is to show 24 knots with 44,000 horse-power in service. It is evident from the above description that the new German ship with her 8 inches of side armor and her enormous battery power is to all intents and purposes a battleship possessing exceedingly high speed.

The production of pig iron during the first six months of 1907 was 13,478,044 tons. The production of the second half of 1907 was 12,303,317 tons.

### THE WORLD'S SHIPBUILDING.

The Herald office, Glasgow, has sent out its usual extensive annual enumeration of the world's shipbuilding and engineering for the past year, 1907, from which can be gathered that the world's total output in vessels and tonnage amounted to 3,523 vessels, 3,277,894 tons, and 3,127,149 I.H.P. Of this large amount the yards of Great Britain produced 1,814,961 tons, 1,776,768 I.H.P.—very much more than half of the world's output—or, in other words, the two little islands in the North Sea set afloat more tonnage in ships and indicated horse-power in engines than all the other countries of the world taken *in toto*. Outside of the British Empire there are fifteen countries building ships, the highest in tonnage output being the United States; the lowest in output being Greece, with her one vessel of 150 tons burden.

The two countries following England in output are the United States and Germany, but the United States can hardly be classed as a competitor, as for years we have built no mercantile ships to compete on the high seas. Here shipbuilding has been for our interior lakes, and in a less degree for our trade protected coastline. Germany is a real competitor of England's. Yet, with her immense resources, her well-instructed, capable people, Germany ought to play a bigger part in the shipbuilding industry than she does. Meantime her private yards are expanding in expectation of naval work, while Great Britain builds many of her mercantile ships more cheaply and more quickly than seemingly can be done in Germany. The following table shows the relative position in regard to production of the three largest shipbuilding countries:

| | 1907. | | | 1906. | | |
|---|---|---|---|---|---|---|
| | Ves. | Tons. | I. H. P. | Ves. | Tons. | I. H. P. |
| United Kingdom..... | 1,825 | 1,814,961 | 1,776,768 | 1,371 | 2,002,571 | 1,846,903 |
| United States ..... | 177 | 455,713 | 304,831 | 207 | 464,671 | 250,761 |
| Germany .. .... . | 507 | 321,372 | 279,097 | 361 | 360,990 | 326,098 |

Fluctuation in a year's shipbuilding has often been remarkable. Last year there was only a slight decline all round. Japan is making rapid strides. In 1907 Japan's output was 148 vessels, 127,752 tons, 187,728 I.H.P. Besides the Imperial dockyards Japan owns five shipbuilding companies, all provided with up-to-date plants. The architecturing and construction of her own production in ships is highly praised, the workmanship being well executed. The Japanese mechanic is behind the Western man in individual output, but he works longer hours, and this has an effect on the comparison to some extent. At any rate, he is a factor to be reckoned with in the world's ship construction. Of late Japan has done a great deal of reconstruction work, but some of her proposals for the future are striking enough. A 20,000-ton battleship is one of them.

Of Greater Britain, or colonial, shipyards, in which India is included, the progress is not marked. The total includes 189 vessels, 30,344 tons, 14,923 I.H.P. India ranks first with an output of over 6,000 tons, and Australia is last on the list with one vessel of 200 tons, 108 I.H.P. Canada, with her interior lakes, has less tonnage to her name than India, but it seems the mother country competes successfully in small vessels for the lake trade.

### COLLECTING THE VENOM FROM A LANCEHEAD SNAKE.

There was recently performed in the reptile house of the New York Zoological Park the curious operation of extracting venom from a lancehead snake for medical purposes. The snake in question is known to zoologists as *Lachesis triganocephalos*. Its venom is used in the treatment of insanity and infectious diseases. Because it must be collected from a living snake, it is extremely valuable. Most of the venom thus far used was obtained as far back as 1828 by Dr. Hering, who collected it from a snake in the upper waters of the Amazon. Small as Dr. Hering's supply was, it was ample for the world's needs until the present day.

In gathering the new supply of venom, the lancehead snake of the New York Zoological Park was held by two keepers back of the jaws and near the end of the tail with forked sticks. It was then grasped by Dr. Ditmars, of the Zoological Park staff, who held in front of it a glass beaker over which was stretched a fine piece of gauze. The snake struck at the gauze, pierced it, and projected a drop of poison, which was caught in the glass. Three times was the serpent allowed to strike. The venom obtained was a yellowish liquid weighing 17¾ grains. This was mixed with 99 parts of sugar and water to every 1 part of poison, and pounded in a mortar until the whole was reduced to a white powder. One dose of the poison as prepared for medical use consists of less than one-millionth of a grain. It is asserted that the 17¾ grains collected will last the world half a century. The SCIENTIFIC AMERICAN hopes to publish soon an illustrated article on the collection and use of the venom.

### NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The regular annual stated session of the National Academy was held in Washington city during April 21 to 23. As this session is largely devoted to business which is transacted at meetings that are not opened to the public, but little beyond results is ever made known. The general interest, therefore, is devoted chiefly to the scientific sessions at which papers are presented and discussed.

The first paper was "A Proposed International Atlas of Land Forms," by Prof. W. M. Davis, who briefly outlined his proposition without asking for any action by the Academy.

Of somewhat more popular interest was "The Geological Age of the Santa Cruz Beds of Patagonia with Restorations of Santa Cruz Mammals," by Prof. William B. Scott. This author contended that the Santa Cruz deposits were not as old in geological time as claimed for them by the South American geologists and argued for this contention most interestedly from biological evidence. He showed that after the land communication between the two hemispheres had been made at the isthmus the fauna of the southern portion naturally passed to the north and that animals from the north crossed to the south; curiously those forms that came north have entirely disappeared, while those that went south have flourished. Thus the rodents and similar small carnivora have survived until the present, while the original varieties from the south have vanished entirely without any modern representative and are only known by the fossil remains that are found in the Western States. From their genealogical horizons he argued for the more modern age of the deposits referred to. He illustrates his paper by a series of restorations drawn by the artist Knight, to whom this part of the work had been confided.

Prof. E. L. Mark showed a series of lantern slides, thus illustrating the "Biological Station for Research, at Agar's Island, Bermuda."

Mr. Bailey Willis of the United States Geological Survey was introduced by Prof. Remsen, president of the Academy, and presented the results of his twenty-three years' study on the geological problem indicated by its title, "Great Tangential Movements of the Earth's Crust," the results of which had been worked out by him under the auspices of the Geological Survey in the United States, the Carnegie Institution in China, and the Smithsonian Institution in Switzerland. He claimed that the formation of many of the mountain ranges was due to the spreading of sub-oceanic areas and showed analogous results that he had obtained with plastic models.

Under the titles, "The Metasilicates of Lime and Magnesia—An Application of Physical Chemistry to Minerals" and "The Exact Measurements of Quantities of Heat, up to 1,500 Degrees Centigrade," Doctors E. T. Allen and W. P. White, who were introduced by President Woodward of the Carnegie Institution, gave the results of recent investigations carried on in the Geophysical Laboratory of the Carnegie Institution.

Dr. L. A. Bauer, who was also introduced by President Woodward, gave a brief account of "Some Results of the Magnetic Survey of the United States," and showed that the three magnetic elements, that is, the magnetic declination, the inclination, and the intensity of the magnetic force, have been determined at about 3,500 fairly uniformly distributed points. His studies showed that it was questionable whether any general terrestrial formula could be established that would represent land observations sufficiently close, and therefore he claimed that the time had come to halt in the establishment of a complex formula involving forty-eight unknowns, or more, which at the very best would give but an inadequate representation of the actual facts of the earth's magnetism.

Dr. Alexander Agassiz, a former president of the Academy, who recently visited the east coast of Africa, under the titles of "The Elevated Reefs of Mombassa and Adjacent Coast" and "The Pelagic Fauna of Victoria Nyanza," briefly described his experiences in the Dark Continent. He found that the reefs of Mombassa, as well as those of other islands, including Madagascar, were of coral origin and had probably formerly been part of continental Africa, but had been separated by the action of solvents on the limestone. He described his journey from the coast to the great lake of Victoria Nyanza in which he found himself irresistibly drawn to make a few hauls with his dredging net, and reported that the catch showed the prevalence of a large and interesting fauna. He also noted the prevalence of mosquito larvæ in abundance, and referred to the fact that the general theory in regard to distribution of animals was that the number of individuals was perhaps greatest at the tropics and that while the number of individuals was less at the polar regions, they were more numerous and were found in herds. His experience seemed to show that this was not the case in Africa, as from the railway train large herds of antelopes and other animals were quite common. Prof. Agassiz further mentioned that the general theory was that the long neck of the giraffe was the result of the stretching of the neck to reach the tops of trees. He was greatly surprised to find the herds of giraffes which he saw feeding on bushes, thus apparently contradicting the generally preconceived notion of the development of the neck of this animal.

Mr. Charles G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, gave an account of the "Recent Work of the Smithsonian Astrophysical Observatory," which he illustrated with lantern slides. The work of this observatory has had to do largely with the determination of various factors in solar physics, and observations have been made both at the observatory in Washington and the observatory on Mount Wilson, California.

Biographical memoirs of deceased members were presented as follows: That of Alpheus Hyatt, by William K. Brooks of the Johns Hopkins University, and that of Asaph Hall, by George W. Hill.

By a recent change of the rules of the National Academy it is now possible to elect not over ten new members a year, and at this meeting the names of eleven scientists were presented for consideration. The fortunate ones were Edwin Brent Frost, who after filling the Chair of Astronomy at Dartmouth College, was called in 1898 to the Directorship of the Yerkes Observatory at Williams Bay, Wisconsin; William Edward Story, for many years editor of the American Journal of Mathematics, and since 1889 Professor of Mathematics in Clark University, Worcester, Mass.; Ernest Fox Nichols, who since 1903 has filled the Chair of Experimental Physics at Columbia University and was the Rumford medalist of the American Academy in 1905; William Francis Hillebrand, Chemist, U. S. Geological Survey since 1880, and President of the American Chemical Society in 1906; William Bullock Clark, Professor of Geology and Director of the Geological Laboratory in the Johns Hopkins University since 1894, and State Geologist of Maryland since 1896; Whitman Cross, who has been connected with the U. S. Geological Survey as Geologist since July, 1880, and ranks as one of the best authorities on Petrography in this country; Edwin Grant Conklin, who since 1896 has been Professor of Zoology in the University of Pennsylvania; Theobald Smith, who has held the Chair of Comparative Pathology in the Medical School of Harvard University since 1896, and since 1901 has been a Director in the Rockefeller Institute for Medical Research; and Simon Flexner, who is eminent as a pathologist, and since 1903 has been Director of the laboratories of the Rockefeller Institute for Medical Research in New York city.

Also the following foreign associates were elected: Prof. S. A. Arrhenius, Director of the Laboratory for Physical Chemistry, Stockholm; Dr. Charles Barrois, Lille, France; Prof. Joseph Larmor, St. John's College, Cambridge, England; Prof. Ivan Petrovic Pavlov, Institute for Experimental Medicine, St. Petersburg; Prof. Hugo Ritter von Seeliger, University of Munich, Germany.

### FOR PRACTICAL FORESTRY

A gift of two thousand acres of forest land in Massachusetts to Harvard University by a number of Massachusetts citizens is one of the most acceptable gifts that a great university could receive at the present time. The nation has adopted a comprehensive forest policy and most of the States have enacted forestry laws. The American people have awakened to the fact that there is peril in the wholesale destruction of the forests that has been going on unchecked, and statesmen keenly realize the necessity for adopting the regulations and methods that obtain in European countries for the preservation and restoration of the forest growth.

Forestry has assumed in this country the importance of a science, and we look to the universities to turn out trained men to apply that science for the benefit of the country. The forest tract presented to Harvard will be well adapted to practical training in all branches of forestry, and its treatment will make a valuable object lesson for owners of woodland.—Bulletin No. 18, American Forestry Association.

The almost world-wide movement to protect and establish forests has reached China, and the first Chinese school of forestry will shortly be opened at Mukden, according to a recent report by Consul-General H. W. Ragsdale, at Tientsin. The Chinese empire is usually pointed out as the worst example, among modern nations, of forest destruction. The floods which are periodically poured down from the denuded mountains are destructive beyond comparison with any other country, and the want of forests is assigned as the chief cause. Wood is scarcer in China than in almost any other region in the world, although the country is well adapted to the growing of trees. In the establishment of a forest school the Chinese government gives evidence that it realizes the need of beginning its reforestation in a scientific manner.—Bulletin of American Forestry Association

## CUTTING METALS WITH OXYGEN.

BY JACQUES BOYER.

The process of cutting metals by a stream of oxygen, patented by the German Oxhydric Company, has been employed with success in numerous establishments for several years. The operation is performed by means of a blowpipe with two nozzles, of which the first delivers an ignited jet of mixed oxygen and hydrogen, and the second a stream of pure oxygen. The pressure is regulated by a gage attached to the oxygen tank. The oxyhydrogen flame and the stream of oxygen strike the same part of the metal, which after being heated by the flame is rapidly cut, or rather burned, through by the oxygen, the temperature being raised to 1,300 or 1,400 deg. F. by the combustion of the metal. The cut is as smooth as a sheared cut and requires little or no finishing. The chemical composition and physical properties of the material are not affected beyond a distance of 1/100 inch from the cut. The precision of the cut varies from 1/25 inch in plates less than 2 inches thick to 1/6 inch in the thickest objects, and the width of the cut varies from ½ to 1/5 of the thickness. Armor plates can be cut in one-twentieth of the time required for mechanical cutting, and the sharply localized heating probably causes less strain than punching and shearing develop. If oxygen costs two cents and hydrogen two-thirds of a cent per cubic foot, the cost of cutting an iron plate 4/5 inch thick is about 7¼ cents per running foot—about half the cost of mechanical cutting.

Special machines are constructed for cutting various objects. The pipe-cutting machine is made in a number of sizes for pipes up to 4 feet in diameter. The nozzles are attached to a frame which is easily adjusted to the proper position on the pipe, and are guided by a small wheel that runs around the pipe. Another machine is designed for cutting flanges and lateral openings in pipes for branch connections. Then there is a machine which cuts oval, round, and square manholes in large pipes and boilers. In the plate-cutting machine used in very thick plates the nozzles are moved in a straight line by a long screw and a hand wheel. Finally, there is a "universal" machine which can be arranged to make curved and polygonal cuts of any pattern in addition to the simpler cuts effected by the other machines. A special form of this universal machine is exceedingly useful in taking apart machinery and steel buildings. It operates by cutting off the heads of the rivets, which are then easily driven out.

The range of usefulness of the oxhydric process is very extensive. The process is regularly employed in many rolling mills, boiler shops, and machine shops, and it is used in steel foundries for the removal of runners and sinkheads on castings. It is also employed largely in cutting plates for the hulls and armor of vessels, in demolishing iron vessels and buildings, and in cutting up scrap.

The advantages of the process are well illustrated by the following examples, taken from actual practice. In the dust catcher of a blast furnace, made of ½-inch plates, seven openings for branch pipes, each 8 feet in diameter, and four holes over 2 feet in diameter, were cut by two men in 6 hours at a total cost, for labor, gas, etc., of $15.50. It would have taken two men at least two days to cut one of the large holes with hammer and chisel.

A brace plate for a locomotive base was cut out of a steel plate 3/5 inch thick in one hour. The aggregate length of cutting was 22 feet.

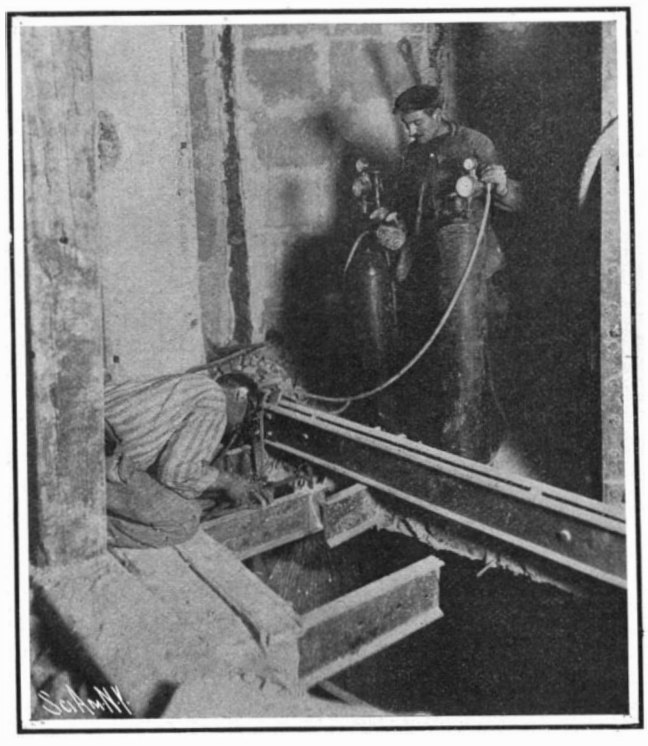
A sinkhead 3 inches thick and 16 inches long was removed from a steel casting in 4 minutes with 40 cents' worth of gas. A sinkhead 1½ inches thick and 10 inches long was cut from the flange of a valve case in 3 minutes. Three runners about 2 inches thick and with an aggregate length of 30 inches were cut neatly from the flanges of another valve case in 11 minutes at a cost of 57 cents. The removal of runners and sinkheads with planing and shaping machines is a very difficult, tedious, and expensive operation; and after it is completed it is necessary to send the castings back from the machine shop to the foundry to be annealed. The oxhydric process is applied in the foundry to castings hot from the mold, which are annealed before they go to the machine shop for finishing.

The dome of a blast furnace was removed by cutting it into four parts with the oxhydric apparatus. The actual cutting was done in 70 minutes, and the furnace, with its new dome, resumed operations two days sooner than would have been possible with the methods usually employed. An old cruiser, containing 14-inch armor and guns 3 feet in external diameter, was reduced to scrap ready for the furnace in 2½ months. The old method would have required 18 months.

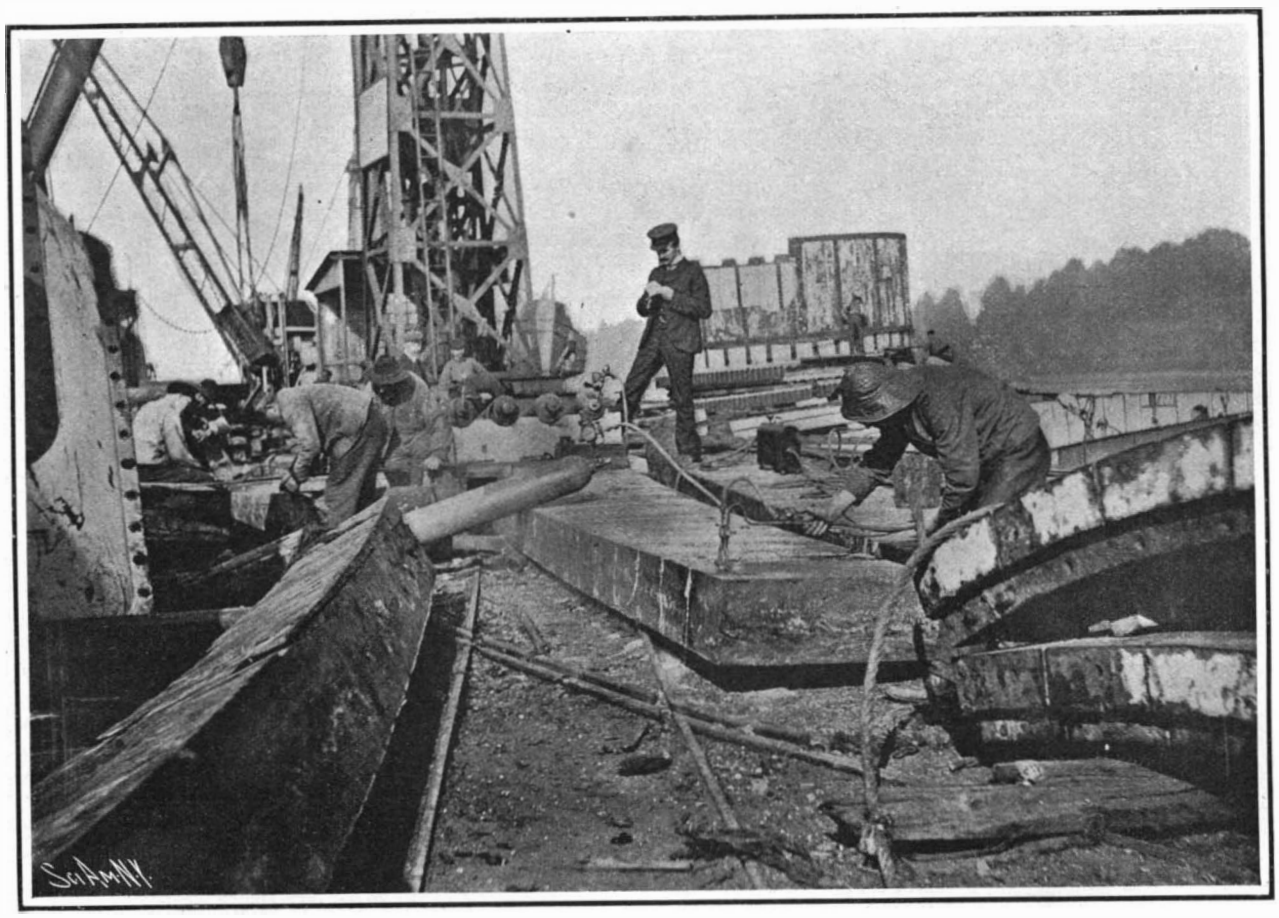
In cutting up scrap precision is not required, and consequently very rapid progress can be made. Four tons of scrap can be cut up in a day by apparatus controlled by one man. With the oxhydric process the work can be done at any place, thus saving transportation charges, and far more cheaply than by the old methods. The process has already been adopted, for cutting scrap, by nearly three hundred railroad machine shops, ship yards, and other establishments.

The oxyhydrogen nozzle of the oxhydric apparatus is cooled by water and other heat absorbed so effectually, that flame striking back is immediately cooled below the point of ignition, and consequently extinguished, so that all danger of explosion is eliminated. The cooling device also serves the purpose of mixing the gases intimately.

The Metal-Cutting Equipment.



Cutting a Steel Beam.



Even Thick Armor Plates Can Be Cut with the Gas-Flame.

### Post Card Instruction.

Consul Frank S. Hannah, in the following report from Magdeburg, tells of the new educational use of pictorial post cards in Germany:

At the recent meeting of the German Geographical Society the idea was advanced for the first time to employ picture postal cards as means of instruction in the schools. The post card industry has made enormous progress in the last few years, and in the last few months cards have been brought into the market illustrative of natural history, political history, and for use in instruction in the German language, which have met with the hearty approval of professors and teachers of reputation.

The school museum at Breslau has undertaken to form a collection of these cards, and for this purpose has requested the various publishers to forward them samples of their output, that it may be determined to what extent they may be used for purposes of instruction. Further, two teachers in Leipzig have established a central bureau for meritorious post cards of all sorts intended for purposes of instruction, collection, and travel. They have also developed and offer for sale two practical systems for the display and filing of the cards. These gentlemen select and arrange the cards most carefully according to pedagogical principles. Such prominent educators as Harms, Tischendorf, Rudolf Schmidt, and others have indorsed the plan of using illustrated cards as an aid in instruction, and even official bodies, such as the Provincial Schulkollegium in Potsdam, anticipate favorable results from them.

Solfatara, a semi-extinct volcano rear Pozzuoli, has opened a new crater 250 feet from the ancient one. It is emitting a voluminous column of sulphurous gases. The activity of Solfatara always is supposed to coincide with the inactivity of Vesuvius.

## GAS PHOSPHORESCENCE AND METEOR TRAINS.

BY HERBERT T. WADE.

One of the most important as well as interesting tasks of the scientist is to reproduce in his laboratory on a small scale some of the grand phenomena of nature, and study the various underlying causes. Indeed, the test of many a theory or hypothesis consists

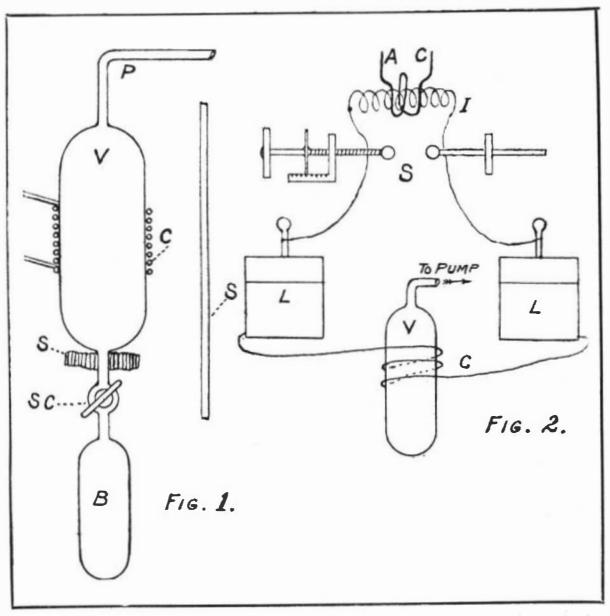
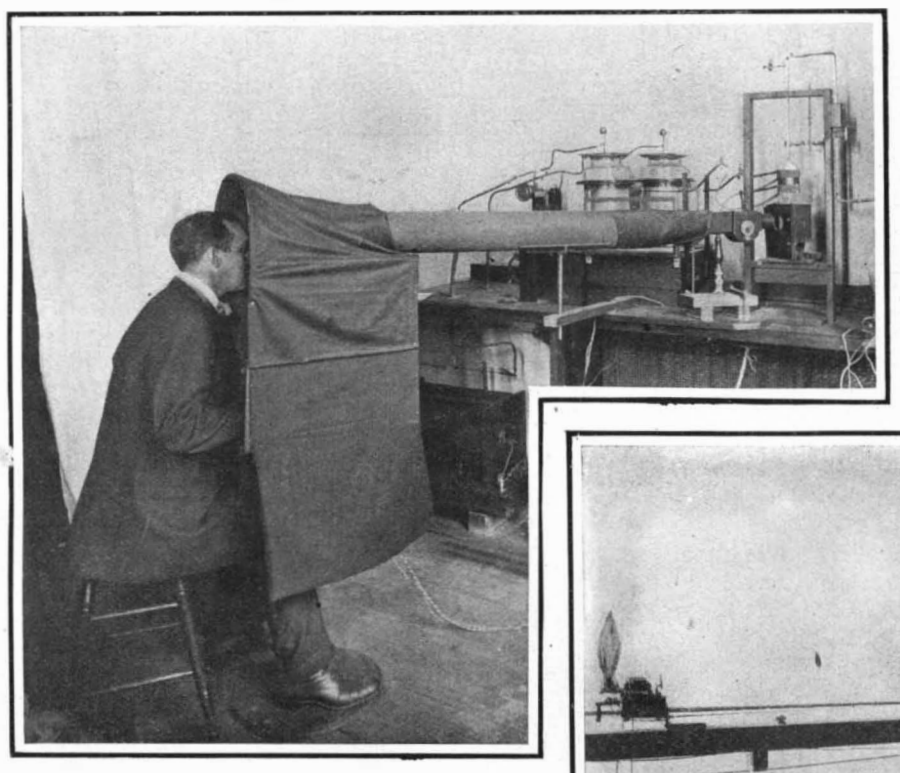



FIG. 1. FIG. 2.

**The Tube and Method of Producing the Glow.**

in its actual demonstration or application in a simple experiment, while conversely the investigator may see in his experimental researches some analogy to natural phenomena which enables an adequate explanation to be given. Such has been the case in the study of the gas phosphorescence or afterglow produced in a vacuum tube by high-voltage alternating currents of electricity passing around it in a cylindrical coil, which has formed the subject of an investigation by C. C. Trowbridge of the Department of Physics of Columbia University. Mr. Trowbridge has found that such an afterglow resembles most closely the effect produced in the sky by the passage of meteors, to which the name meteor trains or streaks has been given by astronomers. Further study of the records of the appearance of meteor trains in connection with this gas phosphorescence seems to establish the similarity of the two phenomena, and enables us to explain the nature and cause of these luminous clouds.

The nature of the afterglow seen in the vacuum tube best can be discussed after an examination of the apparatus as arranged by Mr. Trowbridge, and shown in the accompanying illustrations. A bulb of the shape indicated in Fig. 1 is connected with a Geissler mercurial air pump supplied with a McLeod gage, enabling a vacuum of any desired degree to be maintained and measured. The bulb after many experiments was finally constructed in the form indicated, with a lower bulb *B* attached and connected by a stopcock *SC*. A coil of eight turns of wire, *C*, surrounds the upper part of the tube, *V*, while *SS* are screens that cut off from the eyes of the observer any light produced in the upper bulb, such as that caused by fluorescence. On turning the stopcock the afterglow produced in the upper bulb diffuses into the lower, where it is examined by the observer. To produce a current of high potential in the coil, *C*, use is made of a powerful induction coil *I* (Fig. 2) whose primary is supplied with a 60-cycle alternating current. The secondary is connected across a spark gap *S*, and through two or more Leyden jars *LL* with the coil surrounding the bulb already mentioned.



**Measuring the After-Glow in a Vacuum Tube.**

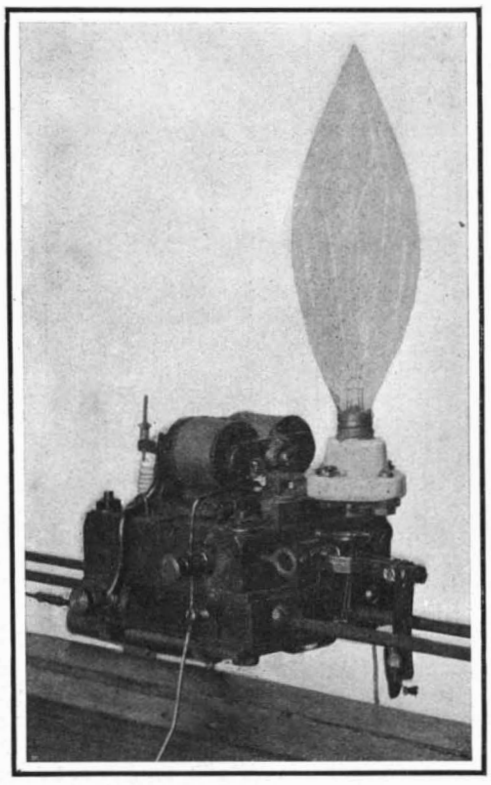
On the passage of the current there is produced within the bulb a discharge, which causes the gas in the tube, in this case rarefied air, to glow and the glass itself to phosphoresce. This action within the tube is due to a condition of electrical stress produced in a ring parallel to the outside coil of wire, through which the high-voltage alternating current is rapidly surging. When this condition of electrical stress is above a certain value, and the gas within the tube is within the proper limits of pressure, a discharge takes place inside the tube, which varies in many essentials from the discharge of the ordinary vacuum tube with electrodes. When the discharge ceases on cutting off the current, the gas in the bulb continues to glow, the luminescence gradually fading away according to the conditions of the experiment. In order to eliminate the effects of the phosphorescence of the glass, the stopcock is turned and the afterglow is allowed to diffuse into the lower bulb, on which the observer's attention is directed, his eyes being shielded from the upper bulb by the screens. The experimental work in brief was to determine the relation of the duration of the afterglow to the pressure of the gas in the bulb and the intensity of the electrical field. It was found that the afterglow was produced when the pressure was between 2.4 millimeters and 0.002 millimeter, and that the maxima of duration occur at low electrical densities. The longest afterglow occurs when there is a white discharge in the tube. At extremely low temperatures, —186 deg. Centigrade, produced by immersing the bulb in liquid air, it was found that while the afterglow was produced, the intensity and duration were somewhat diminished. Now the nature of this afterglow is a difficult matter to determine. It is due probably to an unstable compound formed by the discharge, which breaks down and in so doing gives a radiation which is accompanied by ionization.

Applying the results of this investigation to the study of persistent meteor trains, many points in common soon become apparent. These trains, familiar to observers of the heavens, consist of thin luminous smoke or gas left like a floating cloud in the track of a meteor and retaining its luminosity or glow for as long a period as 30 to 40 minutes.

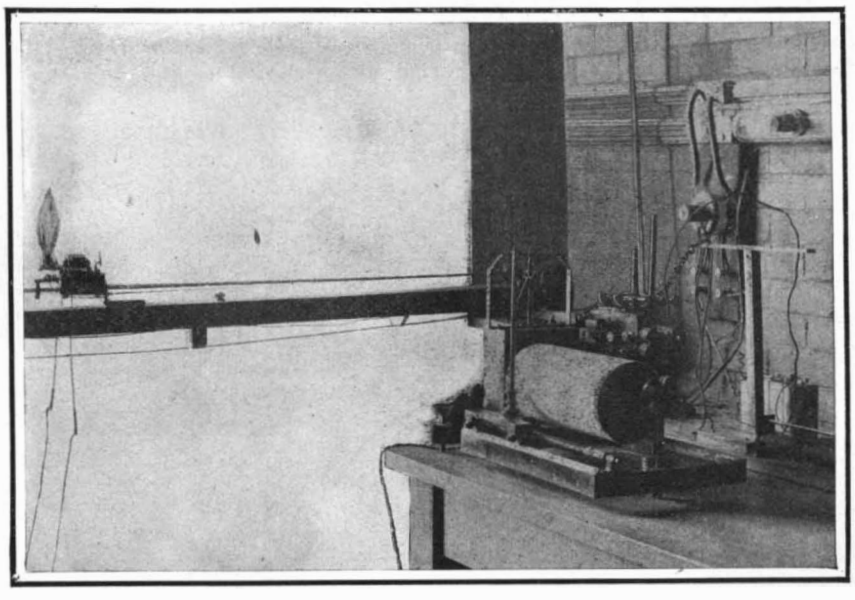
Careful observations have been made and recorded, from which the height of the meteor trains seen at night can be stated at between 50 and 65 miles. They are undoubtedly electrical in origin, and result from the disturbance produced in the atmosphere by the passage of the meteors. These heavenly bodies in their rapid course naturally cause an extremely high temperature, and this is responsible for important changes in the nature and composition of the atmosphere, through which the meteors pass. In this way a condition can be secured where phosphorescence might occur; or as the atmosphere is extremely rarefied, ionization of the gas may follow, and the electrical discharges taking place under such conditions may produce the afterglow so similar to that in the vacuum tube just described. In support of this hypothesis, advanced by Mr. Trowbridge after a careful study of meteor train phenomena and other records, may be urged the fact that the atmospheric pressure at such an altitude would be equivalent to that maintained in the bulb during the experiment, while the rate of diffusion of the glow observed in the meteor trains is of the same order of magnitude as the afterglow

**Sketch of a Meteor Train.**

following the electrodeless discharge. Furthermore, in both cases there must be an absence of moisture, as dryness is an essential to production of the afterglow in the vacuum tube, while moisture could hardly occur at the altitudes of the meteor trains. Also the possibility of production of the afterglow at extremely low temperatures, such as that of liquid air, and at the atmospheric heights mentioned, seems to indicate a further similarity of essential conditions. In addition there is a distinct point of likeness in the type of spectrum of the visible afterglow and the meteor trains, while the phenomena attending the fading of the phosphorescence are markedly similar, indicating that the meteor trains are tubular in form, with the greatest luminosity near the border. While Mr. Trowbridge does not consider his experiments yet absolutely conclusive, nevertheless they seem to explain satisfactorily the long visible duration of the meteor train, while the similarity of color in both cases also argues for the identity of the phenomena in their essence and nature.



**The Standard Lamp Used.**



**Photometer for Measuring the Rate of Decay of Luminosity.**

Recently, by further study with a new form of photometer, as shown in the illustration, Mr. Trowbridge has measured the rate of decay of luminosity of gas phosphorescence, and has found that it is the same as for phosphorescent solids

such as zinc sulphide. This novel piece of apparatus consists of a track about ten feet in length formed by two brass rods under tension, on which runs an electrically-controlled carriage. On this is mounted a standard incandescent lamp, which can be moved away from a screen placed close to a tube containing the phosphorescent gas, and the carriage halted at a series of points along the bar as the phosphorescence fades. Seven readings that directly compare the luminosity of the gas with the standard lamp can be made within ten seconds, and these cover a variation of from one-half to one-twenty-fifth the original intensity of the luminosity. The entire apparatus is operated and controlled electrically by the observer, whose head is covered by the hood shown in the illustration.

Applying the law that the rate of decay of gas phosphorescence is the same as for phosphorescent solids to the decay of the light of a body of phosphorescent gas as great in size as a meteor train, the self-luminous meteor train can be explained on the assumption that it is gas phosphorescence, although the train may be visible for thirty minutes. This same law will also explain the brightening of the sky around the radiant point at the time of meteor showers, known as "auroral light." In this case, however, the effect is due to combination of the feeble phosphorescing of many trains, giving rise to a pale glow in that part of the heavens through which the meteor shower takes place.

## A SUBMARINE BOAT FOR SPONGE FISHING.

BY CAPT. JOURDAN, OF THE FRENCH NAVY.

Sponges are gathered in various parts of the world, but the principal fisheries are on the banks which surround the Kerkenah Islands, off the coast of Tunis, near Sfax. Divers provided with modern equipment have been employed to some extent within the last few years, but most of the work is still performed by nude divers who, weighted with large stones which they leave at the bottom, descend to considerable depths in search of the valuable zoophytes, to the great injury of their lungs and their general health, which is soon ruined by this laborious and dangerous occupation. The dress and apparatus of the professional diver offer obvious advantages, but their cost and complexity put them beyond the reach of most of the sponge fishers, who are very poor and ignorant.

A few years ago it occurred to Vicar-General Raoul of Carthage, who has taken great interest in this local industry, that the progress accomplished in the art of submarine navigation might possibly find a useful application in sponge fishing. He even constructed by primitive methods a sort of submarine boat which, imperfect though it was, worked well enough to confirm his faith in the idea. A local society, formed at his instigation for the study of the subject, decided upon the construction of a submarine vessel devised especially for sponge fishing. The plans for the boat were drawn by the director of the Segne dockyard near Toulon. The vessel is completed and has just successfully passed a series of pressure tests.

The submarine boat of Abbé Raoul is very much smaller and simpler than its naval prototypes, its displacement being less than 9 tons and its buoyancy about 1,300 pounds, with all its water tanks empty. It is 16½ feet long and 5¼ feet in diameter and carries two men. Its general form is that of a cylinder with rounded ends. The only opening is a manhole at the top, which is surmounted by a turret, hermetically closed by a cover that can be operated equally well from above or from below. When the vessel is afloat, it is possible to walk on the convex top with the aid of steel handrails which extend fore and aft on each side of the turret. The vessel is caused to sink by opening three sea-cocks and thus filling as many water ballast tanks. Two of these tanks, placed amidships in the bilge, to port and starboard, have a combined capacity of 154 gallons of sea water, the weight of which balances most of the buoyancy and brings the top of the boat nearly awash. These two tanks are to be kept filled, as a rule, but they can be emptied by means of a hand pump. The third tank, which is placed between the other two, holds only 17 gallons.

The water flows in directly from the sea and is forced out by connecting the tank with two reservoirs which contain air at a pressure of 150 atmospheres. Small movements of ascent and descent can be made and controlled readily by manipulating the compressed air valve. In case of accident a lead weight of 1,500 pounds, which forms the amidship section of the keel, can be instantly detached, causing the lightened vessel to rise rapidly to the surface.

The boat is propelled by means of two steel oars, with feathering blades, similar to those employed in Goubet's small submarine vessels. The oars pass through the hull in water-tight spherical joints which give freedom of motion in every direction. Similar joints are used on the torpedo tubes of warships.

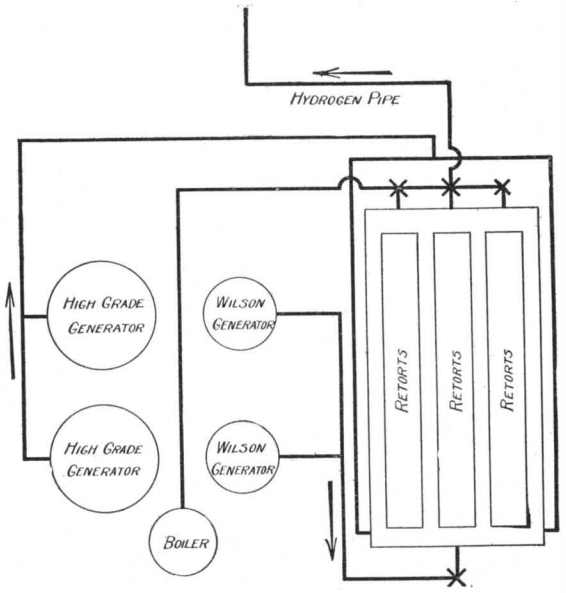
Attached to the forward fixed section of the keel is a wheel on which Abbé Raoul expects his unique vessel to travel over the level bottom of hard sand on which the sponges are found. By regulating the supply of compressed air to the small ballast tanks the pressure of the wheel on the sea bottom can be made as small as is desired, and there is no apparent reason why the vessel should not be propelled over the bottom by the oars—for it has no other motor. The purpose of this device is to evade the necessity of rising from the sea bottom, and consequently drawing on the supply of compressed air in moving from place to place in search of sponges. Raoul's first boat had a similar wheel, which worked very well.

The sponge fishing apparatus consists of a movable arm which projects from the lower part of the curved bow, through a water-tight spherical joint, and carries cutting pincers at its extremity. By means of this device, operated by a man inside the hull, the sponge is cut loose and deposited in a large iron basket suspended from the end of a fixed tubular arm of sheet iron, which occupies nearly the place of the bowsprit of a ship. To the middle of this fixed arm are attached electric lamps and a reflector for the purpose of illuminating the sea bottom, which can be observed through a bull's eye in the bow of the boat. These lamps, as well as those which light the interior of the vessel, are supplied with current by a small battery of accumulators. A ball of lead, attached to a steel wire, can be raised and lowered by means of a windlass inside the tubular arm, and thus serves the purpose of an anchor. The windlass is operated by gearing terminating in a shaft which passes through a stuffing box into the interior of the boat and which bears a crank handle at its inner end. Provision is also made for telephonic communication between the submerged boat and a floating vessel.

This sponge fishing marine boat appears to be a practical and useful vessel, embodying a principle that may well find other applications.—Translated from La Nature for the SCIENTIFIC AMERICAN.

## CHEAP HYDROGEN.

The inflation of ordinary spherical balloons with hydrogen has hitherto been made impracticable by




LANE'S HYDROGEN APPARATUS.

the high price of that gas, which is never less than 1 franc per cubic meter (about 55 cents per hundred cubic feet). Any method of producing hydrogen at a cost little if any higher than that of coal gas would be very welcome to aeronauts, for the lifting power of hydrogen is 1,100 or 1,200 grammes per cubic meter (69 to 75 pounds per thousand cubic feet). Mr. Howard Lane has devised such a method, of which a brief description is here given.

Hydrogen is evolved in the decomposition of water by iron in presence of sulphuric acid, in the decomposition of steam by iron or carbon at high temperatures, and by the electrolysis of water, which furnishes chemically pure hydrogen, but at a cost of about 2 francs per cubic meter ($1.10 per hundred cubic feet).

Lane's process is based on the decomposition of steam by iron at a red heat and produces nearly pure hydrogen at a cost of 1 franc per 10 cubic meters (5½ cents per hundred cubic feet). The merits of the process have been practically demonstrated. The Russian government has ordered two sets of apparatus, each capable of furnishing 200 cubic meters (about 7,000 cubic feet) per hour. The British government has installed a similar apparatus at the aerostatic park at South Farnborough. The officers who have conducted prolonged tests of this apparatus are unanimous in asserting that the quality of the gas produced is equal to that of electrolytic hydrogen, the impurities amounting to only 3 per cent.

The Prussian aeronautic battalion has also asked the war department for a Lane apparatus capable of furnishing 200 cubic meters per hour.

Lane's apparatus comprises a furnace containing three rows of retorts, a small steam boiler and two gas generators, one of the Wilson, the other of the "high-grade" type. The high-grade generator produces from soft coal and other ordinary fuel a gas which contains from 40 to 48 per cent of hydrogen and evolves much heat in combustion. The Wilson generator produces from coal, coke, wood or other fuel an inferior gas which is used in heating the retorts and is sent to them directly, while still hot. The retorts contain fragments of iron.

The operation of the apparatus is as follows: The retorts having been heated to redness by combustion of the Wilson gas, steam is admitted to the retorts of one row, where it is decomposed, with evolution of hydrogen, until the iron has become completely oxidized to magnetic oxide. The current of steam is then turned into the second row of retorts and gas from the high-grade generator is admitted to the first row. This gas, consisting chiefly of hydrogen and carbon monoxide, reacts with the heated magnetic oxide of iron in the retorts, producing metallic iron, water vapor, and carbon dioxide. The solid contents of the retort are therefore restored to their original condition and can be used to decompose more steam and liberate more hydrogen. These two operations are carried on alternately in each of the rows of retorts, in rotation, for an indefinite time during which there is a continuous evolution of hydrogen.

The first operation is represented by the chemical equation:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $3\,Fe$ | + | $4\,H_2O$ | = | $Fe_3O_4$ | + | $8\,H$; | | |
| 168 lbs. | + | 72 lbs. | = | 232 lbs. | + | 8 lbs. | | |
| Iron | | Water | | Magnetic oxide iron | | Hydrogen | | |

The second operation is represented by the equation:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Fe_3O_4$ | + | $2\,CO$ | + | $4\,H$ | = | $3\,Fe$ | + | $2\,CO_2$ | + | $2\,H_2O$ | | |
| 232 lbs. | + | 56 lbs. | + | 4 lbs. | = | 168 lbs. | + | 88 lbs. | + | 36 lbs. | | |
| Magnetic oxide iron | | Carbon monoxide | | Hydrogen | | Iron | | Carbon dioxide | | Water | | |

In the cycle of operations, therefore, 4 pounds of hydrogen, in the cheap form of producer gas, are consumed, and 8 pounds of hydrogen are delivered in a practically pure condition, as appears from the first equation.

The hydrogen, however, contains small quantities of incidental impurities. It is, therefore, put through a washer and a second purifying apparatus before being used for inflation.

The purified gas contains 97.2 per cent hydrogen, 1.8 per cent formene or marsh gas ($CH_4$) and 1 per cent nitrogen.

The cost of the gas may be computed from the following data of experience: 30 kilogrammes of coal, worth in England 12 francs per metric ton, are required to produce 10 cubic meters of hydrogen. An apparatus of the capacity of 200 cubic meters per hour can be operated by 4 men at a maximum wage of 1 franc each per hour. Interest, depreciation, repairs, etc., amount to 0.30 franc per 10 cubic meters. Hence for the cost of 10 cubic meters of hydrogen we have:

| | Franc. |
|---|---|
| Coal $\frac{30 \times 12}{1{,}000} =$ ..... | 0.36 |
| Labor $\frac{1 \times 4 \times 10}{200} =$ ..... | 0.20 |
| Amortization ..... | 0.30 |
| Unforeseen expenses ..... | 0.14 |
| Total cost of 10 cubic meters..... | 1.00 |

This is equivalent to 55 cents per thousand cubic feet.—M. Degoul in L'Aérophile.

### A New Scale Preventer.

A new method of preventing scale in boilers has been invented by F. Brunn, a Russian engineer; it consists in adding a small quantity of linseed to the boiler water. The apparatus, as described in Technitchesky Wyestnik, consists of a copper tank divided into two parts by a fine-meshed horizontal sieve. In the upper part is put a quantity of linseed, and this part is connected with the hot-water supply. The resulting decoction filters through the close-meshed double copper sieve to the lower part, from where it is fed to the boiler through the injector.

The slimy substance of the solution attacks every particle of the forming scale, which does not adhere to the walls of the boilers, and is readily ejected when the boiler is blown out. Even should this mass settle upon the walls, it forms a porous, spongy substance, easily cleaned off. Experiments made at a number of government and other power plants in Russia have all given satisfactory results. New boilers were kept free from scale, and old boilers were gradually cleansed.

The necessary quantity of linseed is about half a pound for every 100 horse-power. Taking 30 pounds of steam as equivalent to one horse-power, the quantity works out at about half a pound of linseed for every 270 gallons of feed water.

The apparatus being merely a divided copper tank with connections to the boiler, has the advantage of great simplicity of construction. It seldom needs any more repairs other than an occasional cleaning of the sieves, and the expenses of running it are very small.

# Correspondence.

### The Carelessness of Railway Employees.

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Fagan, towerman at West Cambridge, Mass., B. & M. RR., states in his series of articles, now appearing in the Atlantic Monthly, that a majority of the railway accidents are caused by carelessness of employees. I think that Mr. Fagan's theory is entirely wrong, and may result in causing the traveling public a great deal of unnecessary anxiety for their personal safety. I have had eighteen years' experience in railroad work, ten years of it as a towerman, and have worked in some thirty different towers, and been a witness to several accidents, but have never known of any that were caused by neglect or carelessness of employees. I will admit that employees are but human, and sometimes makes mistakes that cause accidents. Overwork, long hours, and loss of sleep have been the principal causes of railroad accidents. The most careful men in the world sometimes make mistakes. There are times in every man's life when he will do things he cannot account for.

F. H. SIDNEY,
Signal Dept. B. & M. RR., Terminal Div.

Wakefield, Mass., April 27, 1908.

### Another Optical Illusion.

To the Editor of the SCIENTIFIC AMERICAN:

In vol. xcvi, page 436, of your esteemed paper I find the description by Mr. Gustave Michaud of an experiment, by which the image of an object is painted right side up on the retina, and is consequently seen upside down.

The following experiment, which seems to me still more appropriate to illustrate the phenomenon, may not be generally known to your readers, and may therefore interest you.

Bore a pinhole in a card. Place the card at a distance of about four inches from your eye, and look through the hole at the sky or at a lighted lamp; then move a thin needle in horizontal position very slowly up and down between your eye and the card. You then will see the needle passing to and fro across the pinhole, but always *in opposite direction* to the actual motion of the needle itself.

It is obvious that we do not see the needle itself, but its shadow, cast on the retina, which moves in the same direction as the needle itself.

In the same way I should like to interpret the experiment with the three pinholes, as described by Mr. Michaud, quoted above, by saying that we see upon the luminous dot, brought about by the central hole in one card, *the shadow* cast on the retina by the part of the other card around the three holes.

H. ONNEN, Ph.D.

The Hague, Holland, February 17, 1908.

### Sprinklers in Large Buildings.

To the Editor of the SCIENTIFIC AMERICAN:

Your correspondent, Mr. Frederic Bradlee Abbot, in issue of 25th instant, invites criticism of his letter in reference to "Sprinklers in Large Buildings," from competent persons. The practical experience of the writer dates from 1882. The suggestion that perforated pipes should be required by law in every business building would be impossible to carry out, and would be a decided step backward.

Perforated pipes were discarded many years ago, owing to the necessity of manual control, imperfect distribution of water, corrosion and clogging of perforations—even when bushed with brass—and the excessive water damage caused by flooding large areas where fire was non-existent. There is, however, an ordinance in New York which requires perforated pipes in inaccessible basements of large buildings, but automatic sprinklers may be substituted in lieu thereof, owing to the objections noted above.

As to the statement that automatic sprinklers are at fault in the headway of fires required for heat to reach the sensitive parts: Automatic sprinklers have been installed in constantly increasing numbers since 1874; and since the first fire of record, on February 2, 1877, in which sprinklers operated successfully, thousands of fires have been either totally extinguished or held in check. A recent statement published by one of the principal sprinkler manufacturing companies gives a total of nearly eleven thousand known fires occurring in buildings in which their devices were installed, and in the majority of instances the sprinklers were successful.

At the last annual meeting of the National Fire Protection Association, held in New York in May, 1907, statistics were presented showing a record, compiled from detailed reports of trained insurance inspectors, of 5,458 fires during a period of eleven years, in which the sprinklers were successful in 93.7 per cent of the number of fires, and in most cases the fires were controlled by very few sprinklers. The comparatively small number of failures can be traced to well-defined causes, such as water being turned off, fire originating in unprotected buildings, obstruction of sprinklers, etc.

The Baltimore conflagration would undoubtedly have been prevented, had the building in which fire originated been protected with automatic sprinklers. The insurance rates on thousands of the principal manufacturing and mercantile establishments in all parts of the United States, and in many foreign countries, are based on the protection afforded by sprinklers against serious loss by fire, which is positive evidence of the efficiency of sprinklers.

Fires such as illustrated in the issue of January 11 will continue to occur until approved methods of building construction and fire protection become generally adopted.

P. D. C. STEWARD.

Philadelphia, January 28, 1908.

### A Suggestion for Solar Engine Inventors.

To the Editor of the SCIENTIFIC AMERICAN:

The article by Mr. Frank C. Perkins which appeared in a recent issue of the SCIENTIFIC AMERICAN, entitled "A New Solar Power Plant," has given me great interest in this subject, specially as my residence is in a tropical part of India, where even now the thermometer in the shade shows over 100 deg. Water from a closed tank exposed to the sun is scalding, and a piece of metal which has been lying in the sun's rays cannot be touched.

In this same connection I call to mind a most interesting similar article on "The Utilization of Solar Heat for Industrial Purposes by Means of a New Plane Mirror Reflector," by Carl Guntner, in SUPPLEMENT No. 1586. In this article the author works out the details of the connections of levers to each other and a system of plane mirrors, so that by the movement of only one lever occasionally, all the sun's rays falling on the mirrors are directed upon a cylindrical boiler and kept there.

Now, these two schemes are radically different. One aims at concentrating the heat of the sun falling on a wide area on a small boiler. The second makes no attempt at concentration, but simply endeavors to prevent the escape of the sun's heat naturally falling on the pipes, which in this case compose the boiler.

Now it seems to me there are virtues in both of these methods; and if so, why not combine them? The "hot box" method would most certainly require a large amount of area for the power developed, and further it would be at a great disadvantage both in the early morning and in the afternoon, as it would then receive the rays of the sun at such an oblique angle. This would make it very slow in getting warmed up in the morning and getting started. Indeed, I was very much surprised to read that with water in the boiler, at the latitude of Pennsylvania a pressure of 15 pounds could be obtained.

Now, why would not the wise plan be to combine these two methods? Build the pipe boiler in the hot box with double glass top, as explained in the latter article. Then at both the east and west ends of the boiler arrange a system of mirrors, the line of their axes of course north and south. The mirrors should not be arranged vertically, but one behind and above the other, so that the plane of all the axes would make an angle of say 60 deg. with the ground, and of course incline away from the boiler. Thus in the early morning, the mirrors on the west side would catch and reflect much more heat than the boiler would, and in the afternoon the mirrors on the east side would render a similar service.

The separate mirrors or reflectors would be made of the cheapest and most suitable substance, and have a length and width dependent on structural conditions. They would all be capable of rotation on horizontal axes, so as to properly direct the light falling on them, somewhat as explained in the article above alluded to. A somewhat similar arrangement of reflectors might with advantage be erected on the north and south sides, the slope of the plane of the axes of the reflectors depending some on the latitude of the location of the installation.

Of course, I suppose that such an arrangement is only to be thought of in connection with small power; but it should be specially advantageous not only where fuel is scarce and dear, but where government restrictions upon the use of the ordinary steam boiler are oppressive, as is the case here. The expense of the frequent and enforced government inspection, and skilled attendant, put small steam plants out of the question. It should be possible to secure permission to run a plant as above without either, as, since the degree of heat is limited, and the boiler mostly of pipe, the danger of explosion or accident would be a minimum.

Of course, as the supply of steam would be somewhat limited, its most economical use in the engine should be sought. For small powers the compound engine would be impracticable, but superheated steam, which would achieve the same end—lessening loss from cylinder condensation—should be easily obtained from such an apparatus. Simply keeping a portion of the pipe part of the boiler above the water line, and making sure that it received a generous share of heat, should insure the superheat of the steam drawn from it.

In this part of the country (about 300 miles north of Bombay) there is a great opening for cheap power in small units, say under 5 horse-power, for irrigating from wells. Except during the monsoon the rivers all dry up, but if there were only water, two crops per year could be grown. Oil engines are being used, but the oil is expensive.

Now, where solar heat was to be used for pumping, or wherever cold water be available, the engine could be run condensing, and any well-constructed engine running condensing, and with superheated steam, should give a good account of the heat supplied to it.

These are only the few first thoughts which have come to me on reading the article. It seems to me that if the subject were only determinedly attacked, something could be made out of it.

H. F. BISHOP, B.M.E.

Nadiad, India, March 28, 1908.

### Soap Trees.

Consul-General Richard Guenther makes the following report from Frankfort, Germany:

"Mr. R. Lang, of this city, councilor of commerce and delegate to the Government of Algiers, states that he has just returned from a commercial tour of study in Algiers, where he was called by that government. During his trips he met one of the largest landed proprietors, Mr. S. Bertrand, chairman of the Algerian Agricultural Society, at L'Arba, near Algiers, whose domain comprises many thousand hectares (hectare, 2,471 acres), which are planted with vines, oranges, olive and soap trees. He has succeeded, after numerous experiments, in cultivating a large plantation of soap trees, from which he gathers several thousand tons of berries annually. The soap tree resembles an apple tree of medium growth. The fresh fruit is green, the interior of which, besides the kernel, contains a yellowish gelatinous, sticky substance. The fruit, used for making soap, contains three times as much soap as the 'panama' wood. It seems to be destined to be of great service to the cloth and linen manufacturers, and above all, for domestic purposes, as it can be used to clean linen and silken fabrics and colored embroideries. The use of the soap makes the colors run together."

### The Current Supplement.

In the launching of the "Ersatz-Bayern" last month, Germany set afloat the first of the many "Dreadnoughts" which she is either now building or has in contemplation. The opening article of the current SUPPLEMENT, No. 1688, gives such details as are now available of the ship's armor and armament. A spirited drawing of the vessel by Norman Wilkinson accompanies the text. The majority of manufacturers are dependent upon the combustion of coal for the operation of their mills. The man who is responsible for the continuous and economical operation of a plant should, therefore, know where he can get the best coal for his purpose, and how much he ought to pay for it. E. J. Bailey endeavors to give the manufacturer this information in a simply-worded instructive paper. A small alternating current motor can be constructed by anyone having ordinary skill in the use of tools, and having access to a screw-cutting lathe with a swing of 9 inches or more, by following the clear instructions given by Frederick E. Ward in a paper published in the current SUPPLEMENT. His motor is of the "creeping-field" induction type, and is designed to run on a 100- to 120-volt, 60-cycle single-phase alternating current circuit, such as is now in widespread use for the lighting of dwellings. Working drawings accompany his text, showing the size of every part. This being the day of millions and millionaires, Stanley C. Bailey's excellent little article on the meaning of millions should be read with interest. Walter Irving writes on the starting of gasoline engines. An automatic device has been brought out in France for the protection of fruit trees and the like from the action of frost and hail storms. The Paris correspondent of the SCIENTIFIC AMERICAN describes this system. Bodies which have been but little investigated up to the present time, but which afford a wide field for research, are phosphorescent substances. Some new researches on the subject are described by Prof. Urbain of the University of Paris. William W. Harts states how the debris from hydraulic mining in California is impounded. "The Myth of Malleable Glass" is the title of an article which traces to its source the whole story of a "lost art." Dr. Willis Eugene Everette's paper on "The Formation of Mineral Veins" is continued.

### Distribution of Soap Nut Seeds.

E. Moulie, of Jacksonville, Fla., informs us that he has filled so many applications for free soap nut seeds as the result of his article in the SCIENTIFIC AMERICAN that his supply is exhausted.

**SOME NOTABLE GROUPS OF NORTH AMERICAN BIRDS.**

In the ornithological room at the American Museum of Natural History, New York, there are striking comparative examples of the methods of presenting normal natural history as practised thirty years ago, and to-day. On the ground floor are cases of birds—thousands of birds—in closely-packed tiers, each standing symmetrically on a tiny block of wood, usually with its neck "artistically" curved and its body padded with tow, with little attempt at suggesting the life form or attitude of the bird.

In the gallery surrounding this room are mounted a number of notable groups of American birds. This series, which is known as "The Habitat Groups of North American Birds," does not follow the old custom of arranging according to genera. It is a series of vignettes of bird life of different localities stretching from southern Florida to the Gulf of St. Lawrence, and from Virginia to California. At present there are more than a dozen of these groups completed; the full series will exceed thirty in number, and probably will be completed during 1908. The novel features of these groups consist mainly in their painted backgrounds, which faithfully reproduce typical landscapes in which the birds are found; in the method of lighting; and in the natural pose and arrangement of the birds.

In ground plan the cases containing the groups are straight in front, with a curved background. The groups are seen through a sheet of glass which occupies the central part only of the front. The lighting is from one direction only; from the front, and from above the glass. In bright weather the scene is lighted by reflected daylight; in dull weather the light is a soft glow from hidden electric bulbs. The painting of the background and the arrangement of the objects have been done to harmonize with this method of lighting and limited viewpoint. When the cases are complete, the museum will give us not only a series of vignettes of American bird life, but a series of attractive and trustworthy paintings of characteristic American scenery in novel settings.

We give a few illustrations, which convey some idea of the beauty of the birds and their surroundings; in a later issue we hope to give further examples, together with some account of how the specimens were collected and the cases arranged.

Florida has always been a rich field for the hunter, and a number of the specimens at the Museum come from the southern peninsula. One of these groups is reproduced. Those who see the view of Pelican Island will have an adequate idea of the appearance of a "rookery" of these curious birds. The case, with its truthful background, is decidedly educational. The tree on the left and the stumps beyond remind us that the pelicans were originally tree or bush builders, and that their nests are on the ground because their weight in past years has smashed down the bushes. Beneath the tree a bird broods over her two eggs and newly-hatched young one. Beyond her two young ones are taking regurgitated food from the tip of their parent's bill; and in the center foreground young birds of a larger growth are taking the food from the parent's gullet. The other birds in the foreground show the varying plumage of different ages.

The second Florida group shows a pair of sandhill cranes with their nest set among the reeds of a shallow marsh. The third group, again of water birds—Florida is the land of aquatic birds—shows the curious anhinga or snake bird. The reason for the popular name of this bird is seen in its slender sinuous neck, particularly shown by the bird in the water. With its body submerged and the slender neck and head alone visible, it looks remarkably like a swimming snake.

**Florida is the Country of Aquatic Birds, Which Find Safe Shelter in Its Swamps and Bayous.**

One of the largest of Florida birds is the sandhill crane.

**The Brown Pelican is a Community Dweller.**

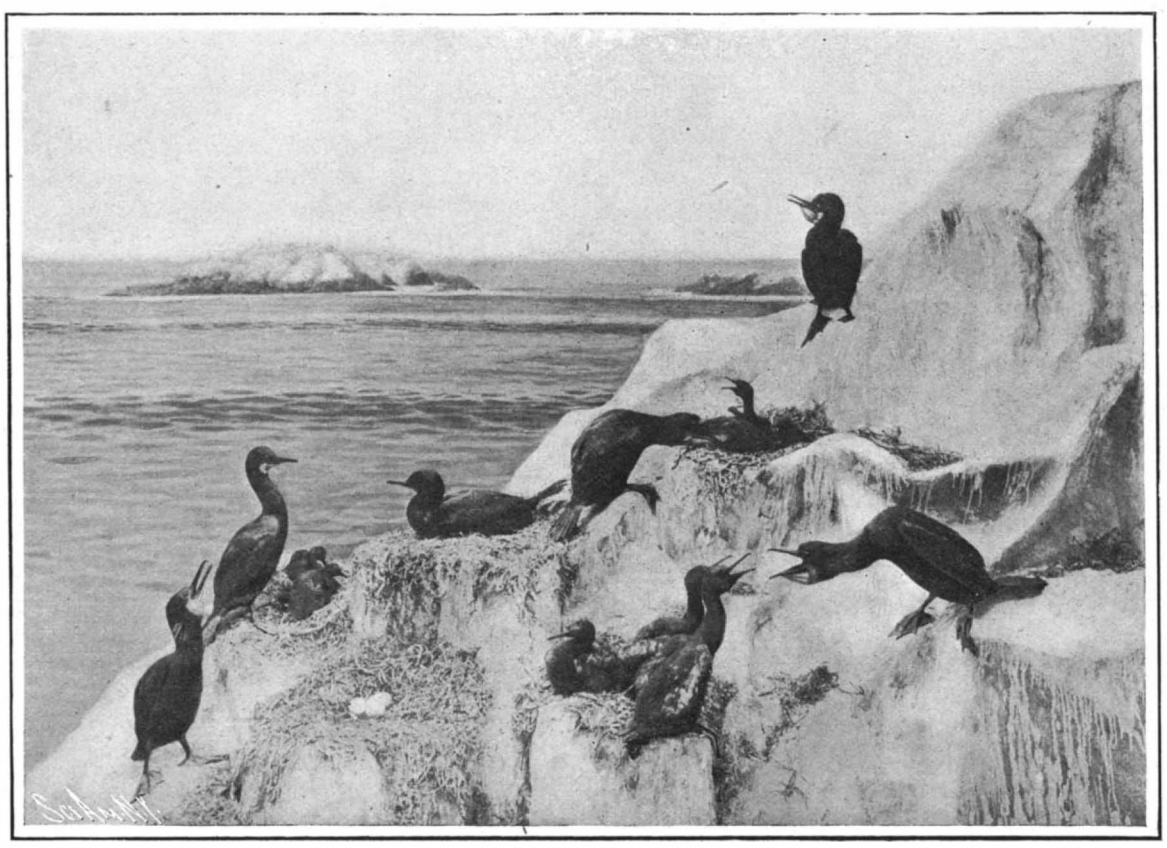
This scene is a reproduction of a great nesting haunt on Pelican Island, which is quite as crowded with the birds as here shown.

Though such water-haunting birds, the anhingas have not water-turning plumage, and after a prolonged swim rest with their wings spread out to dry.

Another illustration carries us to a typical Nebraskan prairie scene. In the early spring morning, just as the dawn is flushing up, the prairie chicken call challenges to each other, and the males strut and fight while the sober plumaged females look calmly on. Finally the Pacific coast is represented by a group of Brandt's cormorants.

One of the most recently completed of the groups represents the wild turkey. This is set amid the brush and fallen leaves of a West Virginia forest, with a stretch of hill landscape beyond. This scenery is carefully painted from a number of studies made in the field; our final illustration shows the artist at work on it.

Our thanks are due to Prof. Frank M. Chapman, the collector of the birds, and to Mr. J. D. Tiggins, who modeled many of the accessories, for their courtesy in supplying information.



**The Pacific Coast Will be Represented by Several Groups.**

One of the earlier ones is the Brandt's cormorant group. The setting shows the rocks off Monterey.

SOME NOTABLE GROUPS OF NORTH AMERICAN BIRDS.

## Electrical Waves as a Disturbing Factor in Photography.

BY DR. ALFRED GRADENWITZ.

One of the most curious phenomena observed by experimenters in photography is the fact that metallic objects by their contact with sensitive silver-bromide layers, or even without any immediate connection, when located at some distance from the latter, will, as it were, produce a picture of themselves without any apparent action of light.

This phenomenon has been interpreted in different manners, without any really plausible explanation having been found, and the hypothesis of vapors liable to act on the plate being given out from the metal is the one most generally adopted. The question as to whether metals may produce a partial self-exposure of the photographic plates contained therein should likewise be mentioned in this connection.

Now, some interesting experiments have been recently made by Mr. Joseph Rieder, of Steglitz, near Berlin, showing that electrical waves, such as used in wireless telegraphy, are apt to produce photographic pictures, and these experiments would seem to shed some light on the problem above mentioned.

The first method suggested for ascertaining the presence of electrical waves is the use of a coherer, that is, a tube filled with metal powder, which under the influence of electrical waves undergoes an alteration in its resistance to the electrical current. Though the action of a coherer is not yet perfectly clear, it may be said, with some degree of likeliness, that it is due to the sparks passing between the metal particles, which becoming melted together will constitute a bridge to the electric current.

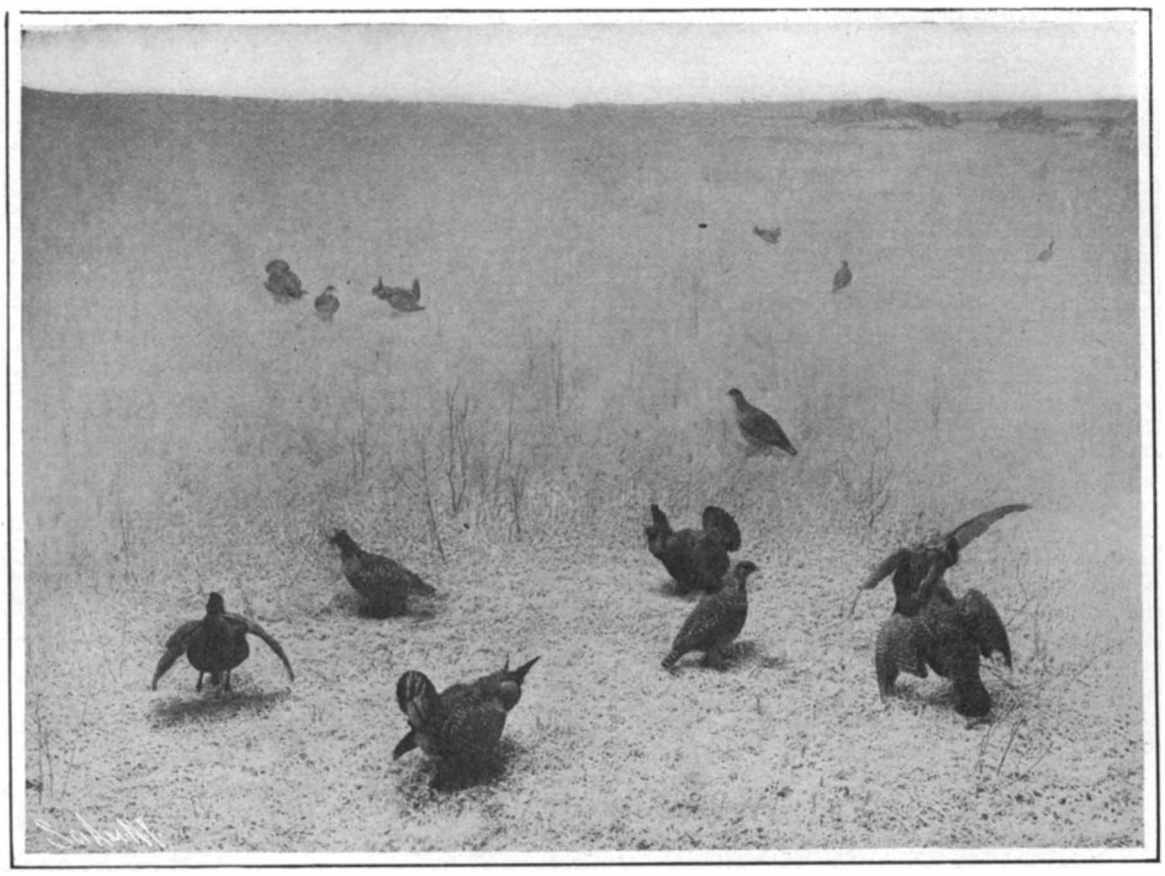
Now, the experiments made by Rieder were as follows: A record made with a shellac solution on a glass plate, before becoming dry, was spread over with aluminium powder, and was brought into contact with a highly sensitive photographic plate and protected against light rays. The plates were then subjected to the effect of electrical waves, and after developing, the record was found to be reproduced distinctly on the sensitive plate. It was at first presumed that the aluminium powder might possibly have exerted some reaction of its own on the silver bromide. However, as no trace of a photographic record was observed on other plates similarly treated but not exposed to the influence of electric waves, the hypothesis that the picture was really due to electric sparks could no longer be discarded.

One curious point in connection with these experiments is that the metal powder at the places of strongest exposure showed the smallest density of aggregation, in opposition to what might be expected. Nor was it found necessary to decohere the powder by means of a trembler before repeating the experiment. In fact, whenever the apparatus was struck by electric waves, a photographic record, the more intense as the action was stronger, was made. Furthermore, the effects were found to be stronger when the back of the glass plate was coated with metal.

In a later experiment some colophony solution was pressed with a rubber stamp on a slightly heated glass plate, and the inscription on the latter was powdered over with aluminium powder, while the back of the glass was provided with a thin copper coating and brought into contact with a silver-bromide plate in a light-proof holder. Sparks were produced by means of a small influence machine. The results of these experiments exceeded all expectation. The machine, located at Mr. Rieder's house, would produce the record on the plate even when the holder was carried down the street to a distance of about seventy meters.

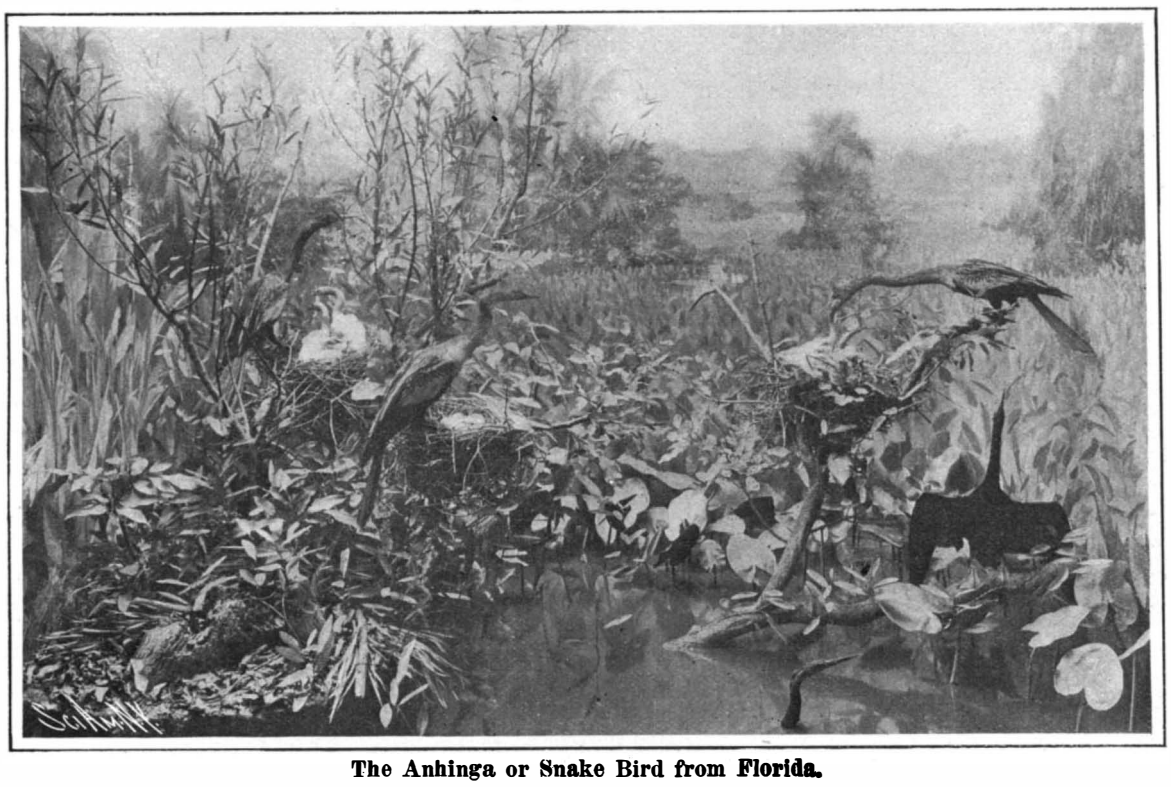
The arrangement described affords an excellent means of directing electric waves, which will be utilized primarily by science. The apparatus provides a means of gaging the duration and intensity of the waves. The character of a thunderstorm can for instance be fixed most accurately, according to the duration, number, and intensity of discharges. A glass plate with a dot of metal powder, coated at the back with a metal sheet, which in turn communicates with an antenna, should be used in this connection. The thunderstorm would then be characterized by the length and intensity of the dots and dashes recorded on a sensitive tape sliding past the metal powder.

The apparatus can also be used to record the dots and dashes of the Morse code. Advantages claimed for this system are that it does not comprise any sensitive mechanical parts, and that as the process is purely chemical, it is free from any delay due to decohering and to the mechanical recording. Hence the speed of signaling should be superior to that of other systems, provided the receiver be sufficiently sensitive.



**An Early Morning Spring Scene in Nebraska.**

The prairie chicken call one another with far-sounding challenges, and when they meet the males strut and fight before the females.



**The Anhinga or Snake Bird from Florida.**

The snakelike appearance of the swimming bird is well shown; and to the right a bird is drying its dripping plumage after a swim.

### Portland Cement Production.

Returns to the United States Geological Survey representing 95 per cent of the Portland-cement production of the United States for the year 1907 indicate that the total output of Portland cement in the last calendar year was approximately 48,000,000 barrels, as compared with 46,463,424 barrels in 1906 and 35,258,812 barrels in 1905. The increase in production in 1907 over 1906 was below the average of previous annual gains, which is said to have been the result of general business depression in the latter part of the year.

**The Background and Settings Are All Carefully Studied in the Field.**

The artist is here painting a Virginia landscape as a setting for a wild turkey group.

**SOME NOTABLE GROUPS OF NORTH AMERICAN BIRDS.**

### A Novel Departure in the Field of Electric Heating.

The principal disadvantage of electric heating systems is that the heated air is supplied to the room directly from the radiator wire. Apart from waste of heat, this completely dries the air of the room.

A scheme of heating by means of electric radiators recently designed by Mr. Gutjahr, of Berlin, utilizes ordinary stoves or fire places, which in order to be started are connected to the electric mains. The interior of the stove comprises an electric radiator, which, owing to the air circulation produced by draft, will raise it rapidly to a high temperature, producing an accumulation of heat. This heat is given off from the tiles to the air of the room in exactly the same manner as in the case of coal stoves, thus avoiding any intensive heating or drying of the air.

The electric radiator consists of a conductive wire, carbon or the like. The stove is a closed one provided with valves to compensate for the air tension.

About an hour is required to heat an average room in the case of normal current consumptions. In the case of current costing 4 cents per kilowatt hour, which is the average price in Germany, the cost of operation of this novel scheme of electric heating would be relatively low.

In designing and arranging the radiators the Newtonian law of heat radiation has been accounted for. According to this law, a radiator will give off its heat the more rapidly as its cross section is greater and the intermediary layer thinner, while the rate of heat evolution on the other hand is proportional to the difference in temperature between the radiator and the surrounding air.

### Automatic Street Lighting in London.

In certain suburbs of London, where street lighting is carried out by incandescent gas, more especially upon the high-pressure system, great success has attended the automatic system of lighting which has been widely introduced. The device is the invention of Dr. Rostin. In one suburban area extending over 16 square miles, 1,300 lamps are so lighted. The device has proved completely reliable, economical, and profitable as well as efficient, since the same benefits accruing from the use of electric light are obtained in regard to gas lighting from a central station. It is especially useful during the winter months, when fogs are frequent. Directly the fog settles down upon the city, the whole of the lamps so fitted can be lighted simultaneously, and extinguished with equal facility and celerity when it lifts. It has been found in this particular suburb that the use of the device has resulted in a saving of 400 lighting hours per lamp, which is equivalent to an economy in gas consumption in regard to 400 lamps alone of some $535 per annum. Furthermore, the incandescent mantles have a longer life as compared with the former system of individual lighting by manual effort, which represents a further saving of $1,200 per year. The cost of fitting up the apparatus to 800 lamps was $10,000, and in the first year's working a total economy of no less than $1,735 was secured, which is equivalent to over 17 per cent upon the capital outlay. In view of this satisfactory result, the company supplying the gas for street lighting purposes are fitting the whole of their lamps, numbering over 4,500 in ail, with this device. In Europe also several cities and towns lighted by gas have similarly adopted the invention with equally striking results.

### A Wicker Lifeboat.

A lifeboat that has more than mere novelty to commend it to the attention of the seafaring community has recently been constructed by C. J. F. de Vos, of Rotterdam. Its claims are essentially practical and there is nothing about this Dutch invention to suggest the fantastic—a characteristic too often encountered in lifeboat patents.

In point of fact there is nothing unusual in the model favored by Mr. de Vos; it is in the adoption of a new material of construction that the value and interest of his invention lie. Its hull is made of cane or plaited wicker work and the inventor, who is already well known in Holland for his marine auxiliary patents, claims for this new method of lifeboat building many advantages over other and older forms.

Its first and foremost advantage is obviously its practically unbreakable character. This has already been put to a severe test in a collision which occurred on the River Maas some months ago between a Belgian sailing yacht and a Dutch motor boat. The violence of the collision was considerably mitigated by the fact that this wicker lifeboat lay between the two craft, and as it turned out acted as a sort of buffer, sustaining no other damage than the breaking of the mast and stays.

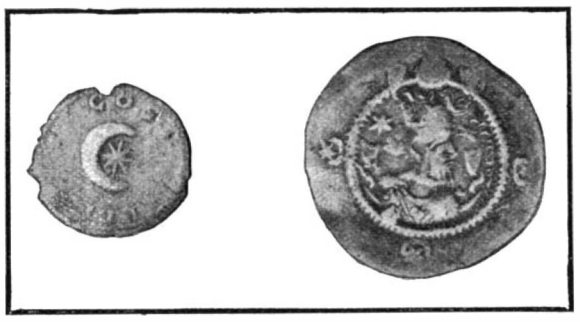
It is unsinkable, it has no rusting materials and therefore requires no paint. It is not liable to leakage, and in addition to being much lighter than ordinary wooden boats it has more room for storing provisions and water. Finally, it costs less money than the usual type of boat.—The Shipping World.

## THE ORIGIN OF THE STAR AND CRESCENT.

BY EDGAR J. BANKS.

It is the popular impression that the star and crescent upon the Turkish flag are of Mohammedan origin. There is, however, a legend which says that in the year 340 B. C., when Philip of Macedon, the father of Alexander the Great, was besieging Byzantium, as Constantinople was then called, and was about to assault the city by night, a strange light appeared in the heavens to warn the inhabitants. The people within the walls, seeing the light, seized their arms and repelled the attack, and Philip, aware that to war with people who were receiving the aid of the gods was hopeless, withdrew. The grateful Byzantines commemorated the victory by giving the miraculous light the form of a crescent and star, and stamped it upon their coins.

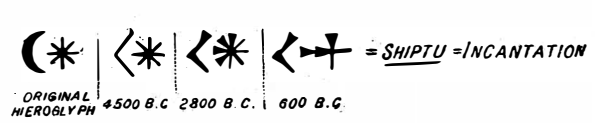
The numismatist sees little truth in the legend, for he finds the star and crescent stamped upon the coins,



**The Star and Crescent on a Coin of Hadrian and on the Border of an Ancient Persian Coin.**

not only of Byzantium, but of ancient Rome, Greece, Persia, Parthia, and even of Macedonia. From the widespread use of the design at so early an age, it would seem that its origin dates from a far greater antiquity. It is now known that the crescent and star were employed by the early Babylonians of more than 6,000 years ago.

The characters of the language of Mesopotamia, like the Egyptian, were originally hieroglyphic, and the several hundred groups of wedges by means of which the language was later expressed in writing, may now be traced back to the original hieroglyphics. One of the early picture words was a crescent and a star, and this picture, which was pronounced *shiptu*, was employed to express an incantation or exorcism, or anything capable of driving the evil spirit from the body of which it had taken possession. Clay tablets recording the ancient exorcisms have been found in the ruins of Mesopotamia, and at the beginning of such tablets appears the sign which developed from the crescent and




**Evolution of the Star and Crescent from the Original Hieroglyph to the Cuneiform Writing.**

### THE ORIGIN OF THE STAR AND CRESCENT.

the star. The symbol, therefore may have been not only the word for incantation, but a charm from which the evil spirits were supposed to flee. In every age in the Orient, the people have possessed similar charms. The Assyrian kings stationed winged monsters with forms half human at their gateways, to keep all evil from entering within the palace. The poorer people suspended clay tablets above the entrances of their houses; the Jews attached the *mezuzoth* to their door posts, and the early Christian believed that Satan fled from the presence of the cross. The modern Oriental may purchase in the bazaars blue glass beads, verses from the Koran wrapped in leather cases, and other devices to serve a similar purpose. The crescent and star formed a symbol which the Mesopotamian of 6,000 years ago employed as a charm.

Among the early peoples of Mesopotamia all of the heavenly bodies were regarded as deities, but the moon, because of the variety of the shapes which it assumes, and the irregularity of its appearance, was the chief of them all. Special reverence was therefore paid it, and some of the oldest and most important of the Babylonian temples, as at Ur and Haran, were devoted to its worship. It is thus easy to understand how the crescent, the symbol by which the moon god was represented, was supposed to have the power to avert evil, and then together with the star it formed the word for incantation. When Babylonia passed into the hands of the Persians, the symbol appeared upon the coins. From the Persians it was transmitted to the Parthians, the Byzantines, the Romans, and the Greeks. Finally the Turks, who succeeded in the possession of the greater part of the countries of the ancient world, adopted it as a device for their flag. The star and crescent were therefore a Babylonian charm which was supposed to possess the power to ward off evil, and to the superstitious its modern descendant, the Turkish flag, should bring "good luck."

### The Charred Ceiling.

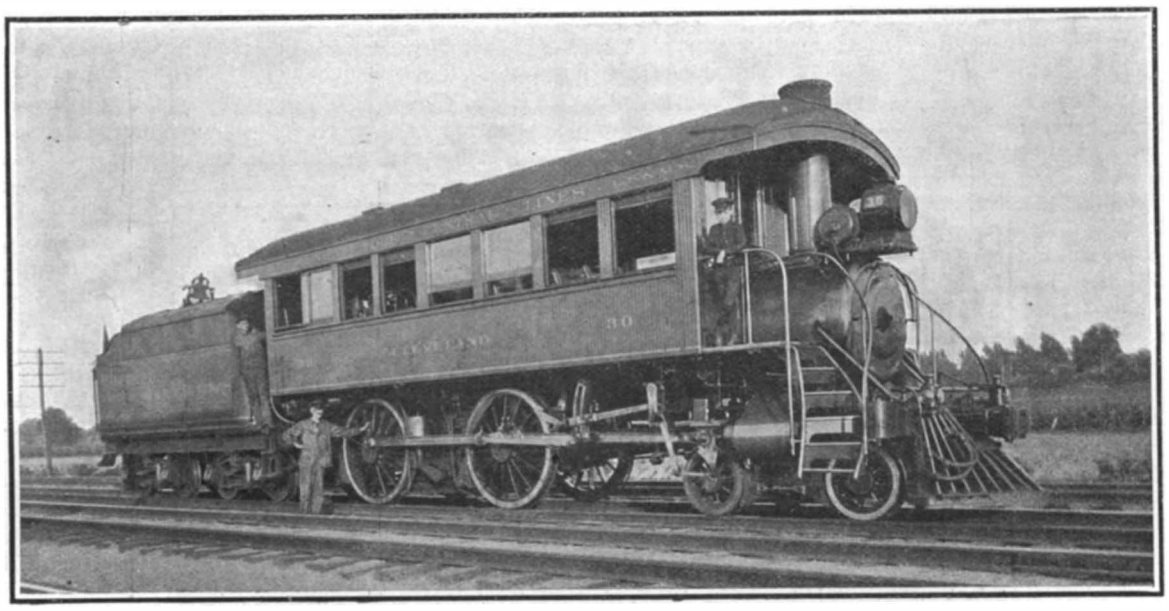
A simple test which everyone can try for the presence of free sulphuric acid in a liquid consists in streaking the liquid upon a piece of white paper, as with a quill pen, and drying the paper before the fire. The track of the sulphuric acid, if any is present, is marked out by a black line appearing as soon as the paper is dry and warm. In short, the acid in this procedure is concentrated until it becomes strong enough to char the paper. The test is quite delicate and is practically demonstrated in the rooms of a house lighted by means of coal gas. Sooner or later the ceiling of a room in which gaslights are burning is blackened, and if chimneys over the burners are used the blackening is more or less localized in a ring immediately over the burner. The common acceptance of this is that soot is deposited, whereas the discoloration may not be due to soot at all. We had occasion recently to examine the circular patches of discoloration which appeared in just those places on a papered ceiling which were immediately above a gas burner. The apparently charred pieces of paper were very acid and sour to the taste and on soaking them in distilled water a weak solution of sulphuric acid was obtained. Further examination showed that the amount of sulphuric acid in the paper was equivalent to as much as 16 grains of pure acid to the square foot. The charred ceiling, therefore, is the result of the action of sulphuric acid derived from the combustion of the sulphur compounds contained in the gas upon the organic substances in the ceiling or in the paper (if it happens to be papered). It is fairly reasonable to suppose that the action of this sulphuric acid is not limited to one part of the ceiling but in course of time becomes general. The use of a chimney on the gas burner concentrates the mischief on the ceiling and hence the more or less rapid appearance of black circular patches immediately over the burners. In the case of a papered ceiling the paper is sooner or later destroyed, chars, crumbles, and peels off. When there is no chimney the products of combustion are to an extent distributed and then the charring is spread over a greater surface, the ceiling getting seared uniformly throughout, but not so intensely, of course, as when the effects of the gases are localized. This is why the inverted incandescent gas burner appears to blacken the ceilings to a less degree than the upright burner provided with a chimney. The products of combustion in the former case are distributed, while in the latter they are concentrated and directed to a comparatively small part of the ceiling. The worst feature from a health point of view of gas lighting is undoubtedly this production of sulphurous and sulphuric acids, for in comparison with these the other products of combustion—namely, the moisture and carbonic acid gas which are both normal products of human exhalation—may for all practical purposes be neglected unless, of course, no precautions are taken in regard to their removal by ventilation. It is to be regretted, therefore, that the hitherto strict requirements concerning the permissible amount of sulphur components in coal gas are in many cases relaxed. We are quite aware that the complete removal of sulphur from coal gas is a very costly business in its manufacture, but if an economical method of freeing coal gas entirely from sulphur could be devised and put into practice the chief argument which hygienic considerations raise against the use of coal gas for lighting and even heating purposes in some cases would have to be dismissed. As it is, the obvious drawback to coal gas containing sulphur compounds is that the products of its combustion are calculated to do damage to the appurtenances of the dwelling room and add to the atmosphere a constituent or constituents which in the interests of health should not be there.—Lancet.

Dantzic Gold Water Liqueur.—*a*. 500 parts meatless curacao shells, 150 parts of cinnamon flowers, 75 parts cloves, 100 parts of lavender flowers are cut or crushed and digested with 6,000 parts of the finest (95 per cent) alcohol and 3,000 parts of water for five days, at 95 deg. F. *b*. Allow to trickle into a flask containing 1,000 parts of alcohol (95 per cent), 10 drops of Turkish oil of roses, dissolve it by heat and pour it, with the digestion fluid and 11,500 parts of the finest alcohol (95 per cent) into the proper storage cask. *c*. Boil 11,250 parts by weight of the finest refined sugar in 22,500 parts of water, clear it during boiling with the whites of two eggs, allow it to become perfectly cold, mix it with the remaining contents of the cask, constantly stirring, and then allow the thus finished product to remain at rest for at least three days. The gold particles are only mixed with it after it has been drawn into bottles.

### A NEW INSPECTION LOCOMOTIVE.

BY W. FRANK M'CLURE.

Two inspection locomotives, differing in some important features from any yet built in this country, have been turned out within the past few months by the locomotive shops of the Lake Shore Railroad at Collinwood, Ohio. The first one to be completed is shown in the photograph. It is already in active service on the Lake Shore road and attracts a great deal of attention among railroad men wherever it goes.



THE NEW LAKE SHORE INSPECTION LOCOMOTIVE.

The chief point of construction which distinguishes these engines from others of similar type, is in the fact that they are each four-cylinder balanced simple locomotives. The combining of the balanced feature with a simple engine has been used in Europe, but these new engines are the only ones of this type in America, and are the only inspection locomotives thus equipped in the world. Below the forward end of the new locomotives are located four equal cylinders, those on the outside being connected with drivers, and the inside cylinders driving through practically duplicate connections to the crank axle. Between the cylinders is a single piston valve with inside admission. The valve chamber has only two steam ports. An opening in the port allows the steam to enter the rear of one cylinder and the forward end of the other simultaneously and in equal amounts. This maintains the balance. The valve gear, as will be seen, is of the Walschaert type.

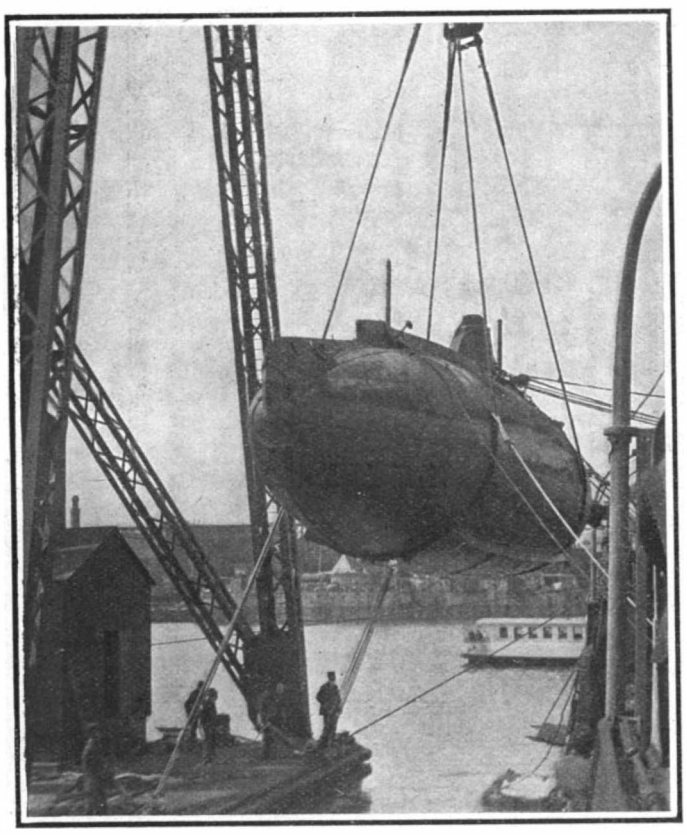
As indicated in the photograph, the observation room and the engineer's and fireman's quarters are under the same roof. There are four chairs on each side of the boiler in the observation room. The interior finish of this room is elaborate. An arrangement for signaling the engineer is located near the right-hand front chair. The front doors, it will be noted, open outward to winding steps. To prevent coal dust from being blown into the observation coach, the tender is equipped with a sheet-iron covering.

The weight of the new locomotives in working order is 126,600 pounds. The weight on the drivers is 85,100 pounds. The diameter of the drive wheels over tires is 63 inches. The wheel base of the engine and tender is about 48½ feet. The boiler is wagon top in shape, and has a working pressure of 180 pounds. The total heating surface is 1,466 square feet. The water capacity of the tender is 4,300 gallons, and the coal capacity 10 tons. The diameter and stroke of the cylinders is 12½ x 20 inches.

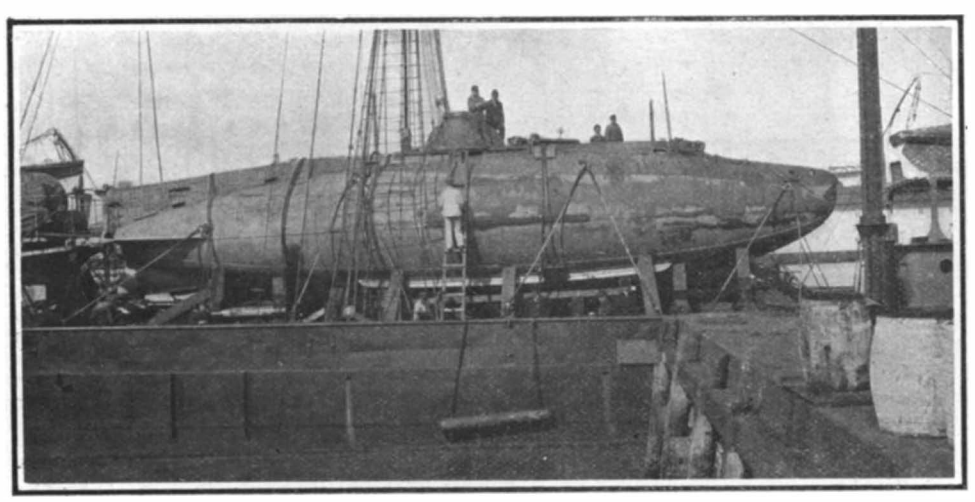
### SHIPPING SUBMARINES INTACT TO THE PHILIPPINES.

The recent shipment of two submarines, upon the deck of a U. S. naval collier, to a destination over half way round the world, is a new departure that deserves more than a passing notice. It is true that the French navy did once transport bodily a very small submarine for a short distance; but the matter was not of sufficient importance to form a precedent for the present attempt.

The "Shark" and "Porpoise" are sister submarines, whose construction was authorized in 1900, and which went into commission in the autumn of 1903. Each boat is 63½ feet in length by 11¾ feet maximum diameter, and its weight is 120 tons, or 240 tons for the two. The common method of transporting submarines is to ship them in sections; a method which allows of their easy stowage in the hold of a ship, and furthermore, makes it a very simple matter to load them in sections on flat cars for transportation by rail. Of course, in this case, the engines, motors, tanks, etc., are knocked down and crated for separate shipment. This was the method followed in transporting the submarines which were shipped to Japan during the late Russo-Japanese war. The novelty in the case of the "Shark" and "Porpoise" consists, of course, in the fact that the boats were shipped intact, and the difficulty was to find some method of carrying them upon the deck of a ship (since they were too large to be placed in the hold) which would be perfectly safe both for the submarines and for the ship itself. As far as the ship was concerned, it was necessary to provide special supports to distribute the effect of the concentrated load, and prevent the vessel from being strained in a seaway. As for the submarines, the problem was to provide some form of cradle in which they could rest without strain, and at the same time to lash them so firmly down to the structure of the ship, that not the slightest movement would be possible in heavy weather.



Floating Derrick Hoisting the "Porpoise" Aboard the "Caesar."



The Submarines "Porpoise" and "Shark" Lashed in Cradles on the Deck of the "Caesar" for Shipment to the Philippines.

SHIPPING SUBMARINES INTACT TO THE PHILIPPINES.

The submarines were placed upon specially-built cradles, laid upon the main deck of the collier "Cæsar." To relieve the strain on this deck, heavy shoring timbers were carried down from the deck frames to the upper floor of the ship's double bottom, and securely wedged in place. A transverse bulkhead of the ship, which extends athwartship at about the center of the cradles, also offered considerable support. Each submarine was carried upon two cradles, one being a regular launching cradle for side launching, as practised at the shipbuilding yards on the Great Lakes, the other, or auxiliary cradle, having its bearing blocks intermediate of those of the launching cradle. When the "Cæsar" reaches the Philippines, the intermediate supports will be wedged up, the end supporting cradles removed, and the launching ways, which will then be built out until they extend 6 feet beyond the sides of the vessels, will be well greased. The boats will then be let down upon the launching ways, and launched over the ship's sides, dropping 7 feet from the ends of the ways into the water.

During the voyage, the weight of the submarines resting in their cradles would be sufficient to hold them in place as long as the water was smooth; but since the ship will probably have to pass through more or less heavy weather, precautions had to be taken to lash the submarines so securely to the hull of the ship, that, for all purposes of movement, they would be practically one with it. To effect this, a system of combined tension and compression was used. Heavy timber shores were set up between the deck and the bilge or rolling keels, as shown in our engraving, and the boats were drawn down tightly upon these by means of ¾-inch wire cables attached at the upper end to ring bolts riveted to their outer shells, and at the lower end to similar bolts riveted to the steelwork of the ship's deck. These wire ropes are placed diagonally to the length of the submarines, and each of them is provided with a turnbuckle.

Similar shores and ropes, not shown in the photograph, were placed at the bow and stern of the boats. The slack of the ropes was then taken up by the turnbuckles, which served to pull the submarines down to a snug bearing upon the shores, the adjustment being also assisted by wedges driven in beneath the shores. Heavy horizontal shores were also placed between the submarines and drawn together in the longitudinal direction by means of 1½-inch bolts, thus wedging the two boats apart against the tension of heavy wire cables which were passed entirely around the boats at two or more points in their length. The advantage of this method of securing the submarines is that, should any of the cables become slack during the voyage, it will be possible, by means of the turnbuckle and the wedges, to bring everything up to a very snug and secure bearing.

Great care was exercised in working out the plans for the launching cradles and the lashing devices. The work was done at the Brooklyn navy yard under the supervision of Naval Constructor Baxter, who, to prevent any possibility of error in the launching, caused a model to be built and launched before any actual work was done in building the ways.

To Stain Bone Brown.—The object must be freed from grease with the acid of petroleum ether, and for five to fifteen minutes must be left, at ordinary room temperature, in a mixture of 40 parts of hydrochloric acid with 1,000 parts of water, washed off with water, and placed in a solution of 5 parts of permanganate of potash in 1,000 parts of water. After coloring has taken place, the object must be removed, washed off with water, and when dry polished. If a more reddish color is desired, the object, before polishing, should be placed in a solution of 10 parts of fuchsine or grenadine in 1,000 parts of water.

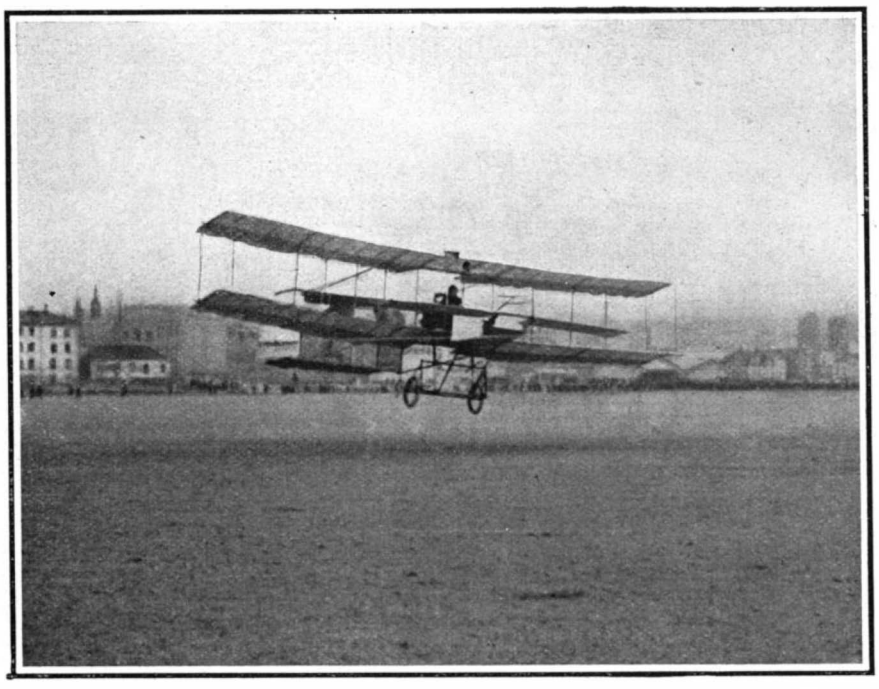
### THE RECORD FLIGHT OF THE DELAGRANGE AEROPLANE.

The photograph which we reproduce herewith shows the Delagrange aeroplane in its record flight of April 11, when it remained in the air 9¼ minutes and covered a distance of about 4 miles. Before making this flight, the water tank had been augmented by a supplementary 5-liter reservoir, so that the total quantity of cooling water carried was 20 liters (5¼ gallons). With this amount of water the engine can be run stationary for 18 minutes without overheating. Thus, it was possible from this point of view for Delagrange to remain in the air 15 minutes, and win the $2,000 prize offered for this performance.

On the 10th of April, M. Delagrange again commenced his experiments. He had not been in the machine for several weeks, yet notwithstanding this he showed his complete mastery of it at the start. Under the supervision of the Aviation Commission of the Aero Club of France, he made a practice flight around a polygon marked out by posts, and flew about 2½ kilometers (1½ miles). He would thus have beaten Farman's record of March 21 (2,004.8 meters, or 6,577.41 feet) if he had not touched the ground once for perhaps three seconds. The witnesses of this flight noted particularly the ease with which the aeroplane flew, its apparent manageability, and the precision with which the aviator was able to take the turns. If one takes into consideration the short time and the relatively few experiments required by M. Delagrange in learning to fly, it would seem that the operation of an aeroplane of this type is easier to learn than the riding of a bicycle. Of course, however, the former requires somewhat more *sang froid.*

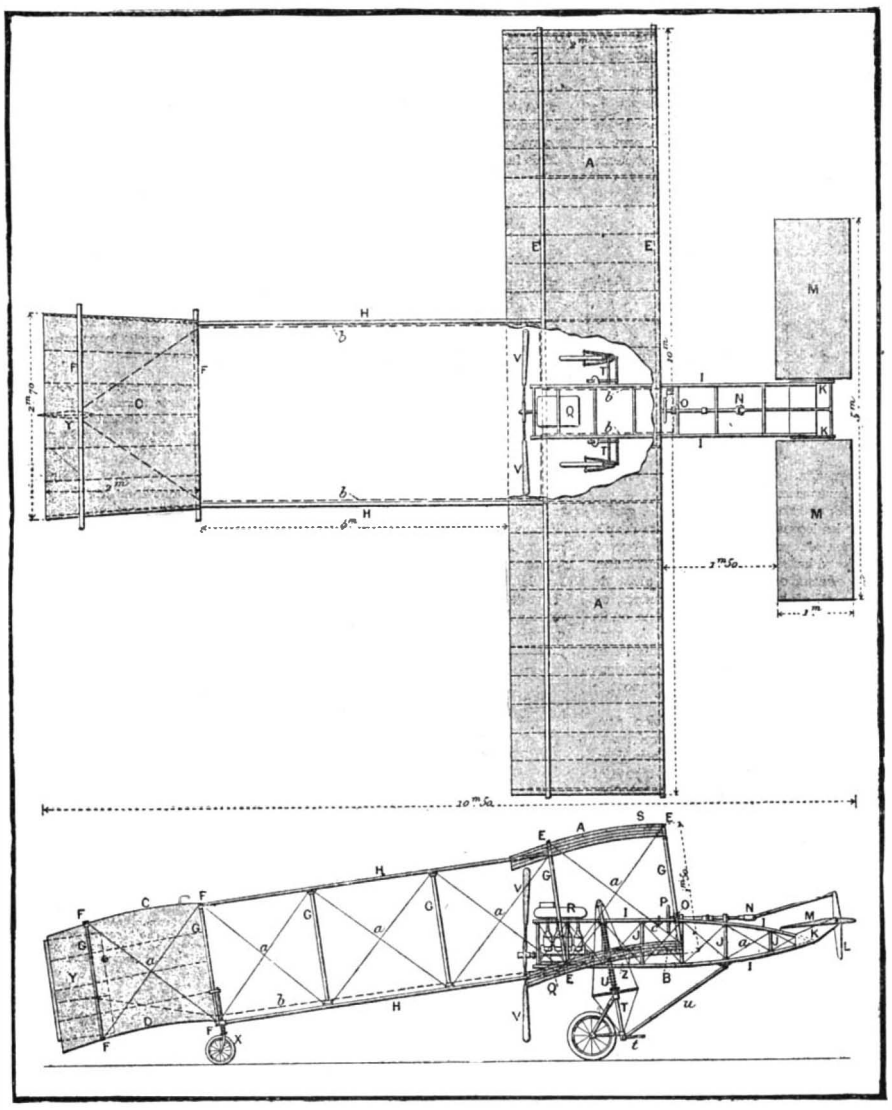
The next morning, April 11, at 11 o'clock, further experiments were made before the Aviation Commission. The course was a quadrangular one, there being four posts located 400, 200, 300, and 300 meters apart respectively. There was a rather strong, irregular, puffy wind, and no flights of any great length were accomplished. The trials were interrupted at noon, and they were not begun again until 5:30 P. M., when the wind was less lively, although there were puffs of considerable strength now and then. This time the course laid out was triangular, having sides 350, 200, and 275 meters in length respectively, or a total perimeter of 825 meters (2,706.68 feet). In the trial made at this time, the machine rose in the air after running along on the ground about 150 feet. During the first two rounds, Delagrange kept close to the ground, and touched the earth twice just after making a turn. The machine always drops slightly just after it makes a turn, and the aviator did not at first allow sufficient space for this drop. He afterward rose to a height of about 10 feet, and then succeeded in making nearly five rounds without touching. The distance covered in this latter part of the flight was officially measured as 3,925 meters (12,877.27 feet) in 6½ minutes; while the total distance covered is given as 5,575 meters (18,290.64 feet) in 9¼ minutes. This would correspond to an average speed of only about 22 miles an hour. As, however, the machine has shown itself capable of a speed of 28.44 miles an hour in straight-line flight, and as undoubtedly the distance covered was considerably greater than that measured between posts, it is safe to say that the machine flew between 3 and 4 miles at an average speed of between 25 and 28 miles an hour. M. Delagrange's new record beats that of Henry Farman, mentioned above, by 1,920.2 meters (6,299.84 feet). Farman remained in the air 3 minutes and 31 seconds without touching the ground, while Delagrange was in the air 6 minutes and 30 seconds, or nearly twice as long. It is interesting to note that the latter's flight was terminated by the failure of the fuel supply. M. Delagrange also is said to have stated that the strain upon his muscles caused by pushing and pulling on the steering wheel, in order to operate the horizontal rudder, was very great, and that he was thoroughly fatigued at the end of his flight. Nevertheless, had the fuel held out, he probably would have flown a greater distance. Several of the 1905 flights of the Wright brothers were terminated for the same reason, and these gentlemen were widely criticised for allowing their performances to be shortened by such a simple cause. It would seem as though Delagrange would profit from the Wrights' experience, and see to it that his fuel tank was filled before he attempted to make a record flight.

For the benefit of those of our readers who are interested in the new science and sport of aviation, we reproduce herewith drawings of the Farman and Delagrange machines. These drawings are fairly accurate, and will give a general idea of the shape and dimensions of the machines which, thus far, have given the greatest public proof of their ability to navigate the air successfully.



**M. Leon Delagrange Making His Record Flight of About 4 Miles at Issy-les-Moulineaux on April 11.**

The aeroplane made nearly seven rounds of a trianglar course in 9¼ minutes. It touched ground twice in the first two rounds, but afterward flew for 6½ minutes without touching. Its speed was between 25 and 28 miles an hour.



**Plan and Elevation of the Farman and Delagrange Aeroplanes.**

### THE RECORD FLIGHT OF THE DELAGRANGE AEROPLANE.

The International Committee on atomic weights has recently announced the changes in the list of elements for 1908. These are, with one exception, practically the same as those announced for 1907. The only notable change is the addition to the list of a new element, dysprosium, whose atomic weight is given as 162.5.

### Apparent Overdevelopment of the Motor Industry in Europe.

Consul Albert Halstead, of Birmingham, states that a report has reached that English city that preliminary steps are being made looking to the combination of several of the larger manufacturers connected with the German motor industry. The consul's report continues:

This is said to be the result of unfavorable sales, due to foreign competition and difficulties in the matter of capital. In connection with this report it is interesting to note that people concerned in the motor industry in the United Kingdom are beginning to believe that the productive power of the industry here has finally equaled and will soon—if it has not already done so—exceed the demand. Purchasers do not now have to wait for their motor cars; as a rule manufacturers are able to deliver to purchasers almost immediately after an order has been received.

There has been a change in the methods of purchasers of motor cars. The idea that one who can afford to do so must have a new motor car every year is disappearing and purchasers are contenting themselves with motors that have satisfactorily met their requirements, instead of feeling that they must have every new device. This is regarded as a natural development partly due to the perfection which motor manufacture has attained. British builders appear to be devoting more attention to the manufacture of cars that will come within the means of people of comparatively moderate income. There is some apprehension that the great productive capacity of the industry in the United Kingdom may result in embarrassment for some motor manufacturers.

The British motor industry has had what is deemed a good year, though the unfavorable summer weather affected it somewhat unfavorably, as it did most decidedly the bicycle industry.

Reports from France indicate that the productive capacity of the French motor industry has considerably exceeded the market for French machines. In the natural course of events the immense development of motor manufacturing, in the United Kingdom, Germany, France, and Italy would result in a decided effort to sell more machines in the United States, but the success of the industry in the United States and the fact that there appear to be more American cars sold abroad, together with the duty of 45 per cent on motor cars entering the United States, and the present American financial depression, naturally offset the tendency of foreign manufacturers to cultivate the American market to a greater extent.

The situation of the motor industry in the United Kingdom, as well as on the Continent, is such as to make the future most uncertain and to later bring about business difficulties such as affected the cycle trade some years ago, but perhaps to not as great a degree. It is not unlikely that greater attention will now be paid in the United Kingdom to the manufacture of motor cars for commercial purposes, which has not been a neglected side of the industry in the United Kingdom, and this should tend to make the industry more permanently stable.

### Trial Flight of the Wright Brothers' New Aeroplane.

According to a newspaper report which has not been authenticated up to the time of our going to press, the Wrights made a preliminary test of their new aeroplane in the presence of some army officers on April 30 at Nag Head, N. C. A two-mile flight is said to have been accomplished, and their machine, it is claimed, could have flown much longer had the aviators so desired.

To Repair Rubber Shoes.—A piece of caoutchouc (India rubber), not too thick, is beveled off at the edges with the aid of a wet knife. The damaged place and the patch are then moistened with oil of turpentine; the parts moistened are brought into contact and subjected, for 24 hours, to a moderately heavy pressure.

## RECENTLY PATENTED INVENTIONS.

### Pertaining to Apparel.

HEELLESS OVERSHOE.—P. H. MARGULIS, New York, N. Y. This invention has reference to rubbers or overshoes, and the object is to produce a heelless overshoe which can be applied to shoes of different types of heel, but which will, in any case, conform closely to the outline of the shoe. It secures a neat fit at the counter and shank of the shoe.

### Electrical Devices.

INSULATOR FOR HEAVY CURRENTS.—L. STEINBERGER, New York, N. Y. This invention embodies features of especial service. At present insulators are apt to be too heavy, cumbersome, and expensive, but Mr. Steinberger by his improvement finds that an insulator may be provided with the requisite strength and dielectric qualities, without excessive weight or undue waste of material, and because of the rigidity and stability secured in improving the insulation, the insulator acquires properties which are of special value in supporting the strain of cables or wires.

### Of Interest to Farmers.

HEN'S NEST.—L. B. LODMELL, Flaxton, N. D. The purpose of the inventor is to provide a construction for a hen's nest, which will prevent the breakage of eggs deposited therein by the hen; which always contains a decoy egg, that will yield to the weight of a newly laid egg and permit it to descend into a safe receptacle, and that will preserve a number of eggs unbroken until removed from the nest.

THERMOSTATIC CIRCUIT-CLOSER.—J. O. WOODS, Riverside, Wash. The object of the present invention is to produce a circuit closing device which will positively act to regulate the heat in an incubator by actuating a damper. It relates to improvements in closers and is designed to be used in connection with incubators, particularly with the construction shown and described in a pending application filed by Mr. Woods, being a division of said pending application.

### Of General Interest.

TYPE-CASE.—J. G. GALLEMORE, Washington, Mo. The object of the improvement primarily is to provide a case in which no opportunity is presented for the type to work or slide under the partitions from one compartment of the case to another, or to be in any wise caught or lodged under the partitions.

MEANS FOR OBTAINING ILLUSIONARY DECORATIVE EFFECTS IN ROOMS AND THE LIKE.—H. L. DELLOYE and A. E. HÉNARD, Paris, France. The invention has for its objects various improvements in rooms with reflecting walls, and comprises more particularly a special arrangement of the interior concave dihedral angles of polygonal rooms, enabling these angles to be caused to pivot. If decorations of different kinds, such as columns, arcades, plants, flowers or the like be provided in the rotary dihedral angles, the entire aspect of the room itself may be changed instantly. The ceiling may be made to harmonize with the variable decorative effects of the angles.

NON-REFILLABLE BOTTLE.—J. B. OGLE, Lancaster, and W. E. BARRIE, Carroll, N. H. By this invention a bottle is provided whose neck has an internal valve seat and a screw threaded passage leading to a valve chamber, the valve having its body portion screw-threaded whereby it may be turned through the screw-threaded portion in the neck of the bottle into the valve seat to position for use.

BOTTLE-TOP.—A. L. BERNARDIN, Evansville, Ind. The inventor provides a screw cap which has a hard metal body portion and a separate discharge tube and secures the latter in connection with the body portion by flanging the lower end of the nozzle or discharge tube along the inner side of the top plate of the body portion. He provides, in connection with the body portion of the top, of the tube or spout having an annular bead to engage above the body portion and an extension below the bead, flanged into locking engagement with the body portion.

METHOD FOR SHRINKING AND FINISHING WOOLEN AND OTHER FABRICS.—F. I. BURGHER, New York, N. Y. The object here is to provide a method and apparatus for shrinking and finishing woolens and similar textile fabrics in a quick and comparatively inexpensive manner, at the same time producing an exceedingly fine and permanent finish, and without danger of disturbing the color in case the dye used is not absolutely fast, the finish being free of creases or other undesirable marks.

DUMPING-BUCKET.—J. HAMILTON, New York, N. Y. The primary object of the inventor is to provide a suitable bucket adapted to contain cement and other substances, to hold said material securely in the bucket while it is lowered under the water, and to readily dump the contents of the bucket when desired. It is designed especially for sub-marine use.

### Hardware.

NUT-LOCK.—T. HAND, Walla Walla, Wash. The invention is in the nature of an improved nut-lock designed to prevent the loosening and loss of nuts from their bolts and designed more particularly for securing the nuts upon the bolts of the fish plates of railroad rails, but applicable for all purposes for which a nut-lock may be used.

CARTRIDGE-RELOADING TOOL.—M. H. DOPPLMAIER, Eureka, Cal. Until the production of this invention it was requisite to employ two reloading tools, for long and short range cartridges, which doubled the expense and rendered it necessary for the hunter or sportsman to provide two tools of the requisite size for long and short range cartridges. By this improvement a single tool suffices for reloading both long and short range cartridges.

STAPLE-PULLER.—G. BLOOD, Westhope, N. D. The puller consists of a pair of pincers. One jaw has a cutting edge and laterally thereto in its outer face a rounded groove for reception of the prong on the opposing jaw, the latter having a cutter co-operating with that of the opposite jaw and also provided alongside the cutter with a prong projecting longitudinally beyond the cutting edge of its jaw and beyond the said jaws' outer face. By these means the prong may be introduced in a staple for drawing it without interference of the cutting edges, the prong being tapered to operate with a wedging action in pulling a staple. It is for use with wire fences.

### Household Utilities.

SCREEN FOR OPEN FIREPLACES.—HANNAH N. L. SHERMAN, Lawrence, and F. M. LAWRENCE, Mastic, N. Y. The aim of the improvement is to provide a screen for open fireplaces or grates, arranged to shield the person or persons in front of the fireplace against intense heat radiating from the burning fuel, to prevent sparks passing from the fuel into the room, and to allow convenient removal, folding and storing of the screen in comparatively little space.

FAN ATTACHMENT FOR ROCKING-CHAIRS.—W. SCHEURER, West New York, N. J. The invention refers to a fan attachment for rocking chairs, and the object is to provide an arrangement whereby a person sitting in a rocking chair will be automatically fanned as the chair rocks. The attachment does not in any way interfere with the freedom of moving the chair from place to place about the room.

COAL-BUCKET.—B. L. BURTT, Jeffersonville, Ind. The aim in this case is to provide a bucket which may be used as a hod for pouring coal into a stove as well as a storage bucket from which the coal may be taken by a shovel and one by means of which coal may be poured from the same into another receptacle without causing dust to arise, as is usual in the type commonly used.

GRATE.—A. V. DAVIDSON and C. R. BEARD, Akron, Ohio. The purpose of the invention is to produce a grate which will effect the combustion of the fuel principally at or above the edges thereof, to the end that the heat developed by the stove or furnace will be increased; this prevents warping of the grate. The grate may be readily shaken or dumped.

MOP-WRINGER.—P. E. GOEHLE, SR., Sault Ste. Marie, Mich. The invention relates to improvements in mop wringers, an object being to provide a machine that will effectually wring the water from a mop with a minimum expenditure of energy. A further object is to provide adjustable means for applying it to a pail or other receptacle.

### Machines and Mechanical Devices.

PHOTOGRAPHIC SHUTTER.—E. L. HALL, New York, N. Y. A single roller only is employed at top and bottom of the frame, the lower roller being a tension and the upper a winding roller, provided with means for regulating the extent of the exposure opening in the shutter, the means being also used to turn the roller jointly with the regulating mechanism when the curtain is to be wound up, and enabling the curtain to be adjusted without turning the winding mechanism.

MEANS FOR OPERATING CLUTCHES.—G. H. GILBERT, New York, N. Y. Various constructions have been devised in which two or more clutches are employed, one clutch serving to operate the other, but in Mr. Gilbert's mechanism the second clutch does not perform any driving function, but serves merely and solely as an extremely simple and efficient means of throwing the main heavy driving clutch into or out of operation.

### Railways and Their Accessories.

AUTOMATIC CATTLE-GUARD FOR RAILWAYS.—R. M. WARK, Spokane, Wash. The improvement is in vertically swinging gates arranged across railway tracks and adapted to be thrown upward, for preventing cattle passing along the tracks. When they attempt to pass along the track they naturally step on the broad planks, and, by their weight, depress the platform, whereby the guard is thrown up in nearly vertical position and effectually obstructs them. Upon retiring the weight boxes restore the platform and guard to the normal position.

HOUSING FOR ELECTRIC ALARM MECHANISM.—J. B. MAYBERRY, Houston, Tex. The invention pertains to electric signals used, for instance, upon railways, and more particularly to a housing for the batteries, bells, and other electric appliances, the arrangement being such as to render these parts accessible, without interfering with movements of the switch handle employed for operating the track and for actuating the signal mechanism.

RAILWAY-TIE.—S. C. NEWLIN and G. W. WILLIAMS, Anderson, Ind. By the conjunction of a wooden frame composed of a wooden base and superposed bars or strips, spaced apart, and a cement covering, a tie is produced which is cheap and light, but strong and rigid. It is much stronger and more rigid than one having a single wooden bar whose cross section equals the aggregate cross section of several smaller superposed bars or strips, because the latter are spaced apart and secured together so that they form a skeleton frame.

RAILROAD-SIGNAL.—J. K. JOHNSTON, Tyrone, Pa. The same signals employed in the day time may be used at night, and all danger arising from the failure of the engineer to distinguish between the different colored lights is eliminated. Signals are given by semaphore arms, and means are provided whereby the position of these arms may be very clearly seen even on the darkest night.

### Pertaining to Vehicles.

HOLDER FOR SPARE TIRES.—E. H. STICKELS, Edgewater, N. J. One purpose here is to provide devices adapted for attachment to an automobile for the purpose of holding one or more spare tires in proper position relatively to the body of the vehicle, and to so construct the devices that they may be quickly and conveniently adjusted to receive different sizes of tires and hold them firmly to place, and so that the devices will not mar or injure the tires.

CART.—C. CARROLL, Chicago, Ill. More particularly the invention has reference to carts, intended, or designed, for use in the collection and delivery of mail. The object is to construct carts of this character, providing them improved facilities over all similar carts now used, or heretofore invented, as far as known to the inventor.

HANGER FOR VEHICLE-BODIES.—J. G. ANDERSON, Rockhill, S. C. As hangers for light buggies, runabouts, and similar vehicle bodies are usually constructed, it is necessary to provide them, near their ends, with openings for the bolts of the clips which hold them to the springs. These openings weaken the hanger. This hanger overcomes the defect and relieves the clip of the weight of the hanger to which they are ordinarily subjected.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

(10742) O. N. says: I am very much interested in mechanical and civil engineering. Please tell me: 1. About what would be the work of a graduate mechanical engineer? A. You can best obtain an idea of the range of possibilities by writing to one of the mechanical engineering schools, whose publication will contain a list of positions obtained by recent graduates. They may start as draftsmen or designers for builders of machinery or other manufacturers, workshop superintendents or assistants for a great variety of manufacturers, assistants in the motive power departments of railways, or foremen of repair shops, salesmen of engines or any of an immense range of supplies or auxiliary machinery, mechanical experts in patent-law work, boiler or machinery insurance inspectors, etc. There is practically no industry which does not depend at some stage of manufacture or development upon the mechanical engineer, and the work of most of the more specialized lines, electrical, hydraulic, pneumatic, marine, etc., engineering is 50 per cent or more covered by the training of a good mechanical course. 2. Also what is the work of a graduate civil engineer? A. Civil engineering in the original sense of the term covered all kinds of engineering work except military, and in that sense the range is still wider, but the general acceptance of the term now has been narrowed, and the majority of civil engineers, calling themselves nothing more, may be found in the following fields: the location, survey, and building of roads, more especially railroads; the design and construction of iron and other bridges required for the same; public works requiring survey, considerable excavation, and masonry or other building (e. g., tunneling, waterworks, dams, pier and harbor work); and the design and construction of steel-frame buildings. Any of the above lines may be specialized to a considerable degree. The graduate might start as rodman or chainman for a surveying party, with chance of much more rapid advancement than others in the same grade not so qualified, or he might start as draftsman in the offices of bridge or other steel-work construction firms, or as a foreman or assistant superintendent of actual construction of public works by contractors or others. 3. Should any person take engineering who is not especially bright in mathematics, but has a liking to the work? A. The engineer is generally more dependent upon mathematics than any other professional man, but a student with a practical or mechanical bent might by application acquire sufficient mathematics to qualify and develop into a more executive and less theoretical engineer in lines where mathematics would be less required.

(10743) C. W. B. says: In Notes and Queries No. 10688 of March 21, in reply to question if the Atlantic cable lies in the bottom of the ocean, you say: "Anything which sinks in water at sea goes to the bottom." That seems reasonable. But the Encyclopedia Britannica says: "Fishes breathe the air dissolved in water by means of gills. The oxygen consumed by them is not that which forms the chemical constituent of water, but that contained in the air which is dissolved in the water." Now our class in science is puzzled to understand how such a light material as air can mix with water at such low depths as many fishes are found. Will you kindly tell us why the great pressure of the water at low depths does not expel the air? A. The presence of air in water is a case of solution of a gas in a liquid, just as ammonic hydrate is a solution of gaseous ammonia in water. The solution is on the same basis as the solution of sugar in water. Jones's "Physical Chemistry," page 168, states the matter in these words: "All gases are absorbed to some extent by all liquids. The greater the pressure, the larger the amount dissolved." This last statement has exceptions, but is true enough for the present case. Water under great pressure in the deep sea would be able to hold more air dissolved in it than under the lesser pressure near the surface. There is no force in the pressure tending to expel the dissolved air. At any point under the surface the pressures are equal in all directions, according to the ordinary law of equilibrium, and thus there is no component of pressure which would cause the air to separate from the water.

(10744) A. A. A. asks: I have an electric (fan) motor, 110 V. D. C., with a rheostat connected. Will you kindly let me know if the amount of current consumed when the rheostat is set at the first (lowest) speed is as great as the amount of current consumed when the rheostat is set at the highest speed? Or in other words, does it cost as much to run the machine at its slowest speed as it does to run it at its highest? A. The power used is not as great in running a motor at a low speed as at a high speed. As you cut out resistance from the rheostat, the speed increases because the current increases.

(10745) C. W. asks: Will you please inform us as to the correct depth that a diver can go in salt or fresh water, and how long he can work at the most extreme depth? Also, would you think it a practicable plan to take a cylinder 14 feet in diameter, 35 feet in length, by letting out the air, to sink it to a depth of from 100 to 200 feet? Do you think the pressure would be so great at that depth that the air could not be forced back into the cylinder in forcing the water out? A. There are cases reported of divers having descended to depths approaching 50 fathoms, though we have no authentic records. They can only remain at such depths for very short periods, the water pressure at that depth being nearly 130 pounds, and the air pressure in a diving suit very little less, with great resultant danger to health from "caisson disease," or compressed air embolism. Caisson work has been carried out at depths requiring an air pressure of upward of 50 pounds (corresponding to a depth of 115 feet) to exclude water, the miners working for 20 minutes or half-hour spells. Doctors investigating complaints due to immersion in compressed air have subjected themselves to 90 pounds pressure with no ill effects, provided they were as inactive muscularly as possible while under pressure and reduced the pressure very slowly. On account of the short spells which can be worked under high pressure, and the time consumed in decompression for the safeguarding of workmen's health, 80 to 100 feet below water level has come to be considered the maximum depth at which work requiring compressed air for the exclusion of water can be *economically* carried on. The use of such a cylinder as you describe is quite possible, and is identical in principle with the well-known diving bell. There is no mechanical difficulty in expelling water at a depth of 200 feet, only 86 pounds air pressure being required.

(10746) F. S. asks: How can I find the magnifying power of a pair of field glasses? Some firms say their glasses magnify, for example, 4½ times, 18 times superficial. Some say their glasses magnify 6 diameters, 36 times superficial. Explain the difference between magnifying 4 times and magnifying 4 diameters, also what the superficial power is. A. The simplest way of finding the magnifying power of a field glass is to look through

one of the tubes with one eye at a brick wall, and with the other eye look directly at the wall itself. You will soon begin to distinguish the magnified bricks seen against the real bricks. You are thus able to tell how many real bricks are covered by one magnified brick. This is the magnifying power of the glass for that distance. Telescopes magnify differently for different distances. The nearer the object, the more will it be magnified by the telescope. When we speak of the magnifying power of a glass, we are understood to mean the magnification for a very great distance. If you know the focal length of the lenses, the magnifying power is found by dividing the focal length of the object glass by that of the eyepiece. The proper mode of designating magnifying power is by diameters, or the linear magnification. Four diameters means that a line an inch long would appear to be four inches long. The other mode is by areas. If each side of a square is magnified four diameters, the area of the square will be made to appear sixteen times as large, hence the superficial magnifying power would be sixteen when the linear magnifying power is four.

(10747) G. W. R. says: A body weighing 200 pounds is moving at the rate of 50 miles an hour. What force is necessary to check and stop its movement? A. Any force, the slightest possible force, will stop a weight of 200 pounds moving with a velocity of 50 miles an hour, if it has time enough allowed for it to act. The problem is one of energy, and is found in textbooks of mechanics. If the time were given, the problem might be solved.

(10748) G. W. B. says: I noticed a phenomenon to-day which I should be very thankful to have you explain. In making maple sugar from the sap of the maple tree, the sap is first boiled down till it is about the same as molasses. This molasses is then boiled down till on cooling the sugar crystallizes. Now in this last operation the pot is filled about one-quarter full of molasses, but still there is danger of its foaming over as it boils. To prevent its foaming over a man stands by the pot with a rod in his hand, on the end of which is a small piece of fat pork. Just as it is about to boil over, he dips his rod in the foam, stirs it around, and the foam at once subsides. A little butter or milk has the same effect. Why is this? A. The action of the fat, which you describe, in preventing boiling syrup from foaming, seems to be the same as that of oil upon water to prevent the breaking of the waves over a ship at sea. The oil forms a viscid layer over the surface of the boiling syrup and holds the surface from breaking.

(10749) H. F. says: We have a controversy here among several persons in regard to the strength of hollow and solid shafting. So if you can answer the following questions, it may prove to be of some value to us besides settling the dispute. Will a 4-inch solid shaft 10 feet long deflect more than a 4-inch hollow shaft 10 feet long, with a 2-inch hole, under the same load? Which will stand the greatest steady load? Will the hollow shaft stand more severe shocks? Would the solid shaft be strengthened in any way whatever by boring a 2-inch hole through it? A. A solid shaft is stronger than a hollow one of the same size, but weaker than a hollow one of the same weight. A solid shaft will be weakened by boring a 2-inch hole through the middle of it. You could not remove material from the shaft without diminishing its strength. It is only when equal weights of material are used that a hollow shaft is stronger than a solid shaft. The hollow shaft will then be much larger externally than the solid shaft. This is the case with the bones of animals and the shafts of the feathers of birds. They are very light in weight, but strong because of the manner in which the material is disposed in the shaft. A solid bone of the same weight would be very much smaller and weaker than the hollow bone.

(10750) C. L. D. says: I am building an induction coil. Where can I get a soft iron core 12 inches long? A. To make a core for an induction coil, get a lot of iron wire such as is used for holding up stove pipe, and cut it into pieces of the proper length. Heat it red hot in a fire, and cool it in the air. This will coat it with oxide, and make it a non-conductor of an electric current from wire to wire. Straighten the wires and make them into a bundle. This is the core. If you intend to make a coil, you should have a description which would give you information upon all such points. Our SUPPLEMENT Nos. 160, 1124, 1527, price 10 cents each, will give you such descriptions of coils.

(10751) J. E. H. says that by looking through a turkey feather he saw the bones in his hand and also saw through a stick of wood. He asks for an explanation. A. The appearance which you describe as seen through a feather is very pretty and real, but it has nothing whatever to do with X-rays. You do not see your bones, nor do you see through a piece of wood. It is a case of the bending of the rays of light as they pass by the fine divisions of the feather, so that those which come from the edge of the stick of wood seem to come from a place quite away from the edge of the stick. The edge of the stick is made hazy on both sides, and it looks as if only the middle of the stick is distinct. Any piece of thin cloth through which you can easily see will answer as well as a feather for this experiment. Thin silk is better than cotton, since the threads are finer. The very finest silk, called bolting cloth, is best for the purpose. This has been reported to us many times as an X-ray experiment. You can see a bone in an iron rod as easily with the feather as in a finger. That it is not a bone in your finger is evident from the fact that the bone seen through the feather has the same shape as the finger. The real bone has a different shape.

(10752) H. P. says: Will you kindly explain in your Queries and Answers how to charge a needle for use in a compass? Have made one of hardened steel, 2 inches long, accurately poised, but after charging it, one end drags down vertically and action is uncertain. It will stop sometimes 45 deg. away from north and south. A. The difficulty with your needle is that it was balanced before it was magnetized. When it was magnetized, the attraction of the earth drew the north pole down. It became a dipping needle as far as was possible, and will not remain horizontal. The remedy is to take off enough from the north end to have the needle remain horizontal. If it is to be used only in your latitude, it will not need further change. A needle free to swing in a vertical plane will have its north pole about 70 min. below the horizontal in this latitude, if the needle was correctly balanced before magnetizing it. Look up the dip of the magnetic needle in some textbook of physics.

(10753) C. E. F. says: Will you kindly inform me why it is that safety matches, which if scratched on any smooth surface will not ignite, will, if they are drawn quickly along the surface of a pane of glass? The kind of matches I refer to are those you buy in boxes which say they can be lighted only by scratching them on the sand and other substances which go to make up that sand, on the outside of the box. A. There seems to be no mystery in the ignition of a so-called safety match if drawn quickly upon a piece of glass, or better upon a piece of writing paper. The friction causes sufficient heat to ignite the mixture in the head of the match. The chemicals used in the head of the match are potassium chlorate or dichromate, some sulphur or antimony trisulphide, possibly a little manganese dioxide, and some pulverized quartz. The chlorate and dioxide furnish oxygen, the antimony trisulphide is easily broken down by heat and burns in the heated oxygen. In the ordinary ignition of the safety match the paste on the cover of the box is composed of red phosphorus and antimony trisulphide. Glue is used to bind these pastes together. Phosphorus is easily heated to the point of ignition by the friction of the head of the match, with the same result as before.

(10754) G. O. B. says: Will you please advise a formula for figuring the required square feet of grate surface for a given size boiler, either by mail or through your query column? A. Both the amount of grate surface required per horse-power and the proper ratio of heating surface to grate surface are extremely variable, depending chiefly upon the character of the fuel and the rate of draft. With good coal, low in ash, nearly equal results are obtained with large grate surface and light draft or with small grate surface and strong draft. Supposing average conditions of clean heating surface and uniform passage of heated gases over them for maximum economy with any kind of fuel, at least one square foot of heating surface should be allowed for each 3 pounds of water to be evaporated from and at 212 deg. F. per hour, or 11.5 square feet of heating surface per horse-power and a ratio of 34.5 of heating to grate surface. To find the heating surface of a horizontal tubular boiler, multiply the length of the shell by 2/3 its circumference in inches; multiply the combined length of the tubes by their common circumference; to the sum of these products add 2/3 the area of both tube sheets; from this sum subtract twice the combined area of all the tubes; divide the remainder by 144, and the result is the number of square feet of heating surface. Divide this by 34½, and it will give a good average for the required grate surface.

(10755) C. F. D. asks: In the SCIENTIFIC AMERICAN of June 1, 1907, on page 448, a description is given of a novel system of storing the energy from a windmill. Will you kindly answer the following questions concerning this apparatus, as I am thinking of installing a similar apparatus, for a little different purpose, however? I want to get 60 pounds constant pressure of water. This means placing the tank 150 feet high or else getting a pressure by some means, as pneumatic pressure or pumping the water into a cylinder against a piston which must be very heavy or else be backed by a strong spring. I suppose the large tank holding say 8 or 10 barrels would have to be made of cast iron turned inside, and the piston would have to be turned and fitted with rings, would it not? Again, could you tell me how to figure out the weight that the piston would have to be to give a pressure of 60 pounds to square inch? Also, how thick would the outside shell have to be? What is your idea of this method compared to the so-called pneumatic system of water supply as to efficiency, also as to cost of installing? A. A modification of the arrangement described in our issue to which you refer could be conveniently applied to your purpose. A cylinder 5 feet in diameter and 8 feet high would contain nearly 10 barrels, and could be made of cast iron, as you suggest, turned to form a cylinder in which a piston turned and fitted with rings or packing could slide. If the whole of the upper surface were covered by the piston, it would necessitate a very great weight to give the desired pressure; the surface area would be 2,827 square inches, and to maintain a pressure of 60 pounds to the square inch the piston would have to weigh over 8 tons. It would be better, therefore, to have a plunger of smaller diameter sliding through a smaller opening in the top; the length of the plunger would, of course, have to be greater, as it would travel farther up or down with admission or withdrawal of the same amount of water, the length of the plunger being inversely as the square of its diameter. A 3-inch diameter plunger with an area of 7 square inches would give the required pressure, with a weight of 420 pounds, but would have to be four times as long as a 6-inch plunger of area 28¼, which would require a weight of 1,691 pounds. The thickness allowed for cast iron pipe, 5 feet diameter, to stand a head equal to 60 pounds is 1½ inches. As, however, the water is to be pumped into the receiver against pressure in any case, what is the object of so large a pressure cylinder? Would it not be more convenient to have quite a small tank in which the pressure could be maintained with less cumbrous appliances? The pneumatic method of water supply consists of maintaining air pressure to the required amount on the surface of water in a closed tank; for this you would require a compressor, in addition to the pump, which might be driven by steam, electrically, or otherwise. The advantage of one system or the other lies principally in the facilities you have for obtaining power for the air compression.

(10756) W. T. E. says: Will you please give me some information in regard to loss of light by mirror reflection in lantern projection of opaque material? 1. What percentage of light incident on a good mirror is reflected? 2. How would the brightness of the images in the following cases compare? (a) Light passes through the condensing lenses, and falls on a picture, from which it is reflected through the objective to a screen. The lantern, of course, is pointed away from the screen. (b) Light passes through the condenser, falling on a mirror, from which it is reflected to the picture; from the picture it passes through the objective, and then falling on another mirror is reflected to the screen. There are two mirror reflections besides the reflection from the picture. A. The amount of light reflected by a mirror varies with the angle at which the light strikes the mirror. A good mirror reflects a very large part of the light which falls upon it. We have no figures for the percentage at the various angles. It can be so easily measured that we advise you to determine it for yourself. The method is given in any laboratory book of physics. The actual brightness of the images of an opaque object projected upon a screen is dependent upon the amount of light the surface of that body can reflect regularly rather than upon the irregular or scattered reflection of the light which falls upon it. White paper is taken to shine with about 0.7 of the brightness of the light which falls upon it, but this is largely due to the diffusion of the light. What the brightness of a projected picture would be under the conditions you name we cannot say, for we have never measured it, and would not like to give the figures of interested parties. We can say that the projection of opaque objects is always done in a room as dark as it can be made, which shows that only a small part of the light reaches the screen. We do not see why two mirrors should be used in the projection of opaque objects.

(10757) A. W. McN. says: The question whether the current induced in an induction coil fitted with condenser is direct or alternating has arisen in the physical science class of our school. The science master cannot answer this, nether can we find any books which state positively that it is direct or alternating. Would you kindly answer this question, giving explanation together with some simple experiment to prove your answer? A. The spark is ordinarily produced in an induction coil by a direct current with an interrupter when the primary circuit is broken. As the current is flowing in the same direction whenever the circuit is broken, it follows that the current through the secondary is always in the same direction. The spark always has the positive end upon one terminal of the secondary, and the negative end upon the other terminal. The secondary current in this case is thus seen to be a pulsatory current in the same direction. If, however, the current used upon the primary coil is alternating, the current in the secondary will also be alternating. And if a current in the primary be a direct current with an interrupter, and the terminals of the secondary be closed together so as to cause a current to flow both on the make and the break of the interrupter, an alternating current is produced in the secondary. Your request for an experiment may be met by setting the coil to work making as long a spark as it can through the air. One end of the spark will be seen to have a white space upon it. If the spark is three inches or so long, this white place may be a half inch long. The white part is at the negative pole or electrode of the coil. The other end of the spark will be of a uniform rosy color and width. This is the end at the positive terminal of the secondary. Since the marks remain, the current must be always in the same direction. Reverse the primary current by the commutator, and these marks change ends. We do not know any easier or more conclusive way of showing the fact.

(10758) J. P. H. says: Will you please explain to me the meaning of the word *cycle* as used in connection with a gasoline engine, and how the word originated? A. Webster's definition of a cycle is "an interval of time in which a certain succession of events is completed, and then returns again and again uniformly in the same order; a periodical space of time marked by the recurrence of something peculiar, as the cycle of the seasons or of the year." In any heat engine, whether operated by steam, gas, hot air, or whatever, the operating fluid goes through a certain series of stages, a complete sequence of which is called a cycle, just as the seasons of the year are said to form a cycle. In a steam engine the stages are simply admission, expansion, exhaust, and a small period of compression, and this cycle is gone through by the steam at both sides of the piston once in every revolution of the engine. In the gas engine the cycle consists of (1) inspiration, the gas being drawn into the cylinder, during one complete stroke; (2) compression of the gas during one complete stroke; (3) ignition and explosion of the compressed gas and expansion of the exploded gases during one complete stroke; and (4) exhaust of the consumed gases during one complete stroke. In the earliest and many present forms of gas engines, in which the explosion of gases took place on one side of the piston only, it therefore took two revolutions or four strokes to make one complete cycle. The term "two-cycle engine" may be taken to mean that there are two separate cycles of operations acting on opposite sides of the piston, but if that sense of the term "two-cycle" is used, the term "four-cycle" is misleading, as it refers to the earlier form of engine and really means "four strokes to a cycle"; in the latter sense the term "two-cycle" (two strokes to a cycle) is analogous.

## NEW BOOKS, ETC.

ANALYSIS OF MIXED PAINTS, COLOR PIGMENTS, AND VARNISHES. By Clifford Dyer Holley and E. F. Ladd. New York: John Wiley & Sons. 8vo.; cloth; 235 pages, illustrated. Price, $2.50.

Numerous books have been written during the past few years dealing with the subject of paints, discussing in a general way the properties of the various pigments and their methods of manufacture. There is scarcely a single work, however, that will serve as a guide to a chemist of ordinary training in taking a can of mixed paint, of practically any shade or tint, making a complete analysis of it and furnishing him sufficient data, derived from a large number of analyses, so that he may interpret the results of his own analysis in a rational manner. The methods given in the following pages should be of interest to advanced college students who may wish to inform themselves on methods of paint analysis; to the industrial chemist who has more or less paint work to do; and especially to the young paint chemist who is just starting out in his career. Each method given in this work has been tested out and its working value thoroughly demonstrated. The various analyses given are believed to be representative of the composition of the pigments they illustrate, and it is hoped that they will be of service in enabling the analyst to pass on paint products with fairness to both the manufacturer and the consumer. The chapters on varnish analysis are admittedly incomplete, for the present literature on varnish, and especially varnish analysis, is meager, and much of it of a contradictory nature.

THE AMERICAN FERTILIZER HANDBOOK. A Standard Directory of the Fertilizer Industry and Allied Trades. Where to Purchase Equipment and Materials Used in Fertilizer Manufacturing and Phosphate Mining. Philadelphia: Ware Brothers Company. 8vo.; paper. Price, $3.

Much interesting text matter and a most useful list of names of firms manufacturing fertilizers. It should be a great aid to the fertilizer and allied trades.

PRACTICAL STEAM AND HOT WATER HEATING AND VENTILATION. A Modern Practical Work on Steam and Hot Water Heating and Ventilation. With Descriptions and Data of all Materials and Appliances Used in the Construction of Such Apparatus, Rules, Tables, Etc. By Alfred G. King. New York: The Norman W. Henley Publishing Company. 8vo.; cloth; 402 pages, 302 illustrations. Price, $3.

This book is the standard and latest work published on the subject and has been prepared for the use of all engaged in the business of steam, hot water heating and ventilation. It is an original and exhaustive work,

telling how to get heating contracts, how to install heating and ventilating apparatus, the best business methods to be used, with "Tricks of the Trade" for shop use, rules and data for estimating radiation and cost and such tables and information as make it an indispensable work for everyone interested in steam, hot-water heating, and ventilation. The reputation of Mr. King as a heating expert and a practical writer of the day is sufficient guarantee that his work represents the best practice of the present day and is exhaustive in text, diagrams, and illustrations. All technical matter too dense to be readily understood by the man of average education has been eliminated, and Mr. King has, in a breezy, entertaining and yet simple manner, described all of the principal systems of steam, hot water, vacuum, vapor, and vacuum-vapor heating, together with the new accelerated systems of hot-water circulation, including chapters on up-to-date methods of ventilation and the fan or blower system of heating and ventilation.

TINPLATE WORK. Edited by Paul N. Hasluck. With Numerous Engravings and Diagrams. Philadelphia: David McKay. 16mo.; cloth; 160 pages. Price, 50 cents.

The British magazine "Work" is noted for the practical articles upon various subjects, usually dealing with the mechanical trades, that appear in its pages. A number of them on tinplate work form the contents of this book. The objects for the manufacture of which directions are given include flower trays, lanterns, biscuit cutters, kettles, etc.

DETECTION OF THE COMMON FOOD ADULTERANTS. By Edwin M. Bruce. New York: D. Van Nostrand Company. 16mo.; cloth; 84 pages. Price, $1.25.

The best and simplest qualitative tests for all common food adulterants in the form of a small book. It also contains a brief statement of the adulterants likely to be found in a given food-product and the reason for their use. Anybody with a knowledge of chemical nomenclature and some familiarity with laboratory manipulation will find it useful.

HOW TO READ PLANS. By Charles G. Peker. Fully illustrated. New York: Industrial Publication Company. 12mo.; cloth; 46 pages. Price, 50 cents.

To be able to read plans is very important to a workman, yet it is quite a difficult accomplishment to acquire unless one has had the necessary instruction. "How to Read Plans" explains all the technicalities of the draftsman's art, and furnishes an excellent course of instruction for all who desire it.

AIRSHIPS PAST AND PRESENT. By A. Hildebrandt. Translated by W. H. Story. New York: D. Van Nostrand Company, 1908. 8vo.; 361 pages; 222 illustrations; price, $3.50.

This is a very complete historical work on the subject of aerial navigation. Starting with the early history of the art, and with a description of the first hot-air balloons, the author discusses the theory of the balloon proper and the development of the dirigible balloon. This part of the work is quite complete and traces the development from 1852 to the present time. One chapter only is devoted to flying machines, but in this some of the best and most historic aeroplanes are described. Other chapters are devoted to kites and parachutes, as well as to the development of the military balloon in Germany and other foreign countries. Ballooning as a sport, scientific ballooning, and balloon photography, are treated in very thorough fashion. A chapter is given to the interpretation of photographs taken from balloons and to the photographic outfit required for this purpose. The question of photographing from kites and rockets is also discussed, and a chapter is devoted to the use of carrier pigeons in balloons. The final chapter of the book is on "Balloon Law." The work is illustrated with many excellent photographs taken from various heights, as well as with pictures of well-known aeronautic men, and diagrams of the various apparatus used.

PRACTICAL PHYSICS. A Laboratory Manual for Colleges and Technical Schools. By W. S. Franklin, C. M. Crawford, and Barry Macnutt. Vol. III. Photometry—Experiments in Light and Sound. London and New York: The Macmillan Company. 12mo.; cloth; 80 pages. Price, 90 cents.

The third volume of the set of laboratory manuals by Messrs. Franklin, Crawford and Macnutt. It contains a series of experiments in light and sound, methods of photometry, spectrum analysis, and others of like nature are detailed in this useful work.

TASCHENBUCH DER KRIEGSFLOTTEN IX. JAHRGANG 1908. Mit teilweiser Benützung amtlichen Materials. Herausgegeben von Kapitänleutnant a. D. B. Weyer. Mit vielen Schiffsbildern, Skizzen, Schattenrissen und 1 farbigen Tafel. München, J. F. Lehmanns Verlag. Price, cloth, $1.50.

Capt. Weyer's annual appears this year in a somewhat enlarged form. In addition to the complete tables of navies in which the size, armor, armament, complement, and speed of each vessel are given, and in addition to the excellent photographic and plan views of each class of ships, silhouettes of the different types have been published. These silhouettes are of particular value to seamen because by their means the vessels of any of the powers can be identified from a considerable distance. The comparisons of the various navies, naval expenditures, programmes, ordnance, wharves, etc., complete the information which the little book contains. We have had occasion frequently to refer to Capt. Weyer's annuals, and we have no doubt that the present book will prove in every respect as accurate and as trustworthy as its predecessors.

WHITTAKER'S ARITHMETIC OF ELECTRICAL ENGINEERING FOR TECHNICAL STUDENTS AND ENGINEERS. Containing 72 Worked Examples and Exercises. London and New York: The Macmillan Company. 12mo.; cloth; 139 pages. Price, 50 cents.

Students of electrical engineering usually find it very difficult to turn their theoretical knowledge to account, owing to their unfamiliarity with the mechanical operations involved in the problems they are endeavoring to solve. By an assiduous application to the examples contained in this book the requisite skill may be readily secured.

JOURNEYS AND OBSERVATION. By T. A. Rickard. San Francisco: Dewey Publishing Company, 1907. 8vo. Price, $3.50.

Mr. Rickard is the editor of the Mining and Scientific Press and is thoroughly familiar with his subject. Some 255 pages of the book are devoted to the Mines of Mexico and the remainder to "Across the San Juan Mountains." This results in a separate pagination which is not very pleasing. The book is profusely illustrated with half-tone engravings inserted. Many of these illustrations are of great interest. The book is very readable.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY. Road Pamphlets. No. 1. Earth Roads. No. 2. The Earth Road Drag. No. 3. Stone and Gravel Roads. No. 4. Cutouts and Bridges. Published by the State at Madison, Wis.

From the educational standpoint, the four little pamphlets on road-making published by the State of Wisconsin, mark a big step in advance. So little is known of this subject, that tax-payers are too often obliged to bear a heavy burden due to the ignorance of the officers intrusted with keeping the public highways in order. The general circulation and distribution of such literature among the inhabitants of a State would be sure to raise the standard of excellence of roads very materially, indeed.

MERIDIAN CIRCLE OBSERVATIONS MADE AT THE LICK OBSERVATORY, 1901-1906. By R. H. Tucker. Sacramento: W. W. Shannon, Superintendent of State Printing, 1907. Cloth; 11½ by 9 inches; 269 pages.

"The observations for the Zodiacal Catalogue include all the stars in the list arranged by Sir David Gill in 1899, in conformity with the resolutions of the International Conferences for Fundamental Stars. The design of the list is to furnish accurate places for heliometer measures of the planets, and of the moon. . . . It includes 2,798 stars, ranging from 90 to 139 per hour, with an average of 117."

TWO YEARS AMONG NEW GUINEA CANNIBALS. By A. E. Pratt. Philadelphia: J. B. Lippincott Company, 1908. 4 illustrations; pp. 359; octavo. Price, $4.

The author, who has spent thirty years wandering over the face of the earth in search of specimens for natural history museums, gives an account of some of the happenings incident to a long stay in Papua or New Guinea. The book contains interesting descriptions of some of the customs of the cannibal but apparently amiable inhabitants of the second largest island in the world, as well as glimpses of the hardships incidental to roughing it. An outline of the methods of collecting butterflies and moths forms an interesting chapter. It is often the case that men who do things have not a well-developed gift of telling about them. The author's experiences should have resulted in a more coherent and informing book, but as it is, his subject and the handling of it are not without interest.

MODERN BATHS AND BATH HOUSES. By William Paul Gerhard. New York: John Wiley & Sons. 8vo.; cloth; 311 pages, illustrated. Price, $3.

Discussing the "uplifting power of the bath," a writer in Modern Sanitation recently commented on the fact that "while for many years the subject of 'bathing' enjoyed a long slumber, it is gratifying to note the now constantly increasing reference to bathing and its benefits." In his practice as a sanitary engineer the author has had ample opportunity to deal with the subject of baths and bath houses in a practical way. Many of the baths in State hospitals and other institutions were installed under his superintendence, and the plumbing, water supply, and sanitary features of a number of the public or people's bath houses in the city of New York were planned and specified by him. A recent extended trip abroad gave the author an opportunity to visit numerous bath houses with a view of learning, by a personal inspection, how they are planned and equipped on the Continent of Europe. He saw much regarding hydrotherapeutic, electric-light, and air and sun baths that is probably new and of interest to his readers. During a month's stay at one of the best-known sanatoriums in Germany (Dr. Lahmann's, at a small place called "Zum Weissen Hirsch," near the city of Dresden) he took various water baths, electric-light and steam baths, and also the air baths twice daily, beginning with them during cold winter weather in February, 1907. He became particularly impressed with the health-giving qualities of these air baths. In order to make them better known in the United States he devoted an entire chapter to this novel form of bathing, and included in it some interesting illustrations.

RECENT CYANIDE PRACTICE. Edited by T. A. Rickard. San Francisco: Mining and Scientific Press. 8vo.; cloth; 338 pages, illustrated. Price, $2.

A compilation in convenient form of the series of articles on cyanation appearing in the Mining and Scientific Press between January, 1906, and October, 1907. The different methods used in widely separated localities in many cases, are described by the leaders in this branch of metallurgy.

# INDEX OF INVENTIONS

**For which Letters Patent of the United States were Issued for the Week Ending April 28, 1908,**

**AND EACH BEARING THAT DATE**

[See note at end of list about copies of these patents.]

Account keeping apparatus, individual, W. W. Robinson ..... 885,958
Account keeping device, W. W. Robinson .. 885,957
Accumulator controller, W. B. Mason ..... 886,145
Acetylene generator, R. H. Welles, reissue. 12,787
Advertising device, I. O. Thorley ..... 886,275
Aerial apparatus, M. B. Sellers ..... 886,159
Air compressor, Simpson & Lishman ..... 885,877
Air cushion block, compressed, C. C. De Witt ..... 886,193
Auger, earth, J. S. Park ..... 886,242
Autographic register, Schirmer & Stern ..... 886,015
Automobile, A. H. Wright ..... 885,822
Automobile circuit breaker, W. C. Horner .. 885,848
Automobile steering gear, G. E. Miller ..... 885,940
Automobile radiator, C. Schmidt ..... 886,016
Awning, sewing, C. A. Connan ..... 885,913
Awning, W. W. & F. L. Schwemer ..... 886,256
Axle box lubricating packing holder, car, J. S. Patten, reissue ..... 12,786
Bag fastener, G. L. Edgerton ..... 885,739
Bait, artificial, J. E. Pepper ..... 885,861
Bale tie, W. D. Ferris ..... 885,917
Bale tie making machine, W. D. Ferris .... 885,916
Band cutter and feeder, A. Bottcher ..... 886,178
Barrel, drying out, C. L. Warner ..... 885,813
Barrels, kegs, and the like, combined cover and follower for, T. M. Dansby ..... 886,040
Basket, L. E. & L. B. Reynolds ..... 886,308
Bearing, roller, F. M. Foote ..... 886,200
Bearings, lubricating device for center, R. T. Senter ..... 886,080
Bed, M. Wensauer ..... 886,022
Bed, knockdown, S. S. Hanson ..... 885,995
Belt fastener, P. A. Hudson ..... 886,215
Bending machine, A. Wood ..... 886,027
Binders, shocking attachment for, W. H. Perrin ..... 886,326
Blanching apparatus, E. J. Vaudreuil ..... 886,097
Block. See Air cushion block.
Bobbin and spindle connector, H. E. Hughes 886,297
Bobbin driving means for rotatable spindles, A. D. Morse ..... 885,855
Book and card system, combined loose leaf, C. P. Ferrero ..... 886,320
Bookkeeping system, C. Sherwin ..... 886,081
Boring machines, drill and bit holder for, J. Marston ..... 886,228
Bottle and sealing cap, J. M. Deemer ..... 885,734
Bottle handling apparatus, H. J. Chilton ... 885,912
Bottle holder and rack, I. J. True ..... 885,806
Bottle holder, nursing, M. L. Surprenant ... 886,270
Bottles and other receptacles, stopper for, Ganucci-Cancellieri & Cappelletti ..... 885,743
Bottling apparatus, A. A. Pindstofte ..... 885,785
Box, H. P. Roberts ..... 886,250
Brace, D. O. Wilkins ..... 885,819
Bracelet, T. D. Giguere ..... 886,121
Brick kiln, S. T. Rawles ..... 885,954
Brick kiln furnaces, firing tool for, E. H. Callaway ..... 885,720
Brush, dusting, R. N. Fickett ..... 886,046
Brush, horse, J. B. Pfau ..... 886,153
Buckle, P. I. Andrews ..... 886,029
Bung closure for barrels, O. A. Hilgermann. 885,997
Butcher's block, L. Rowe ..... 886,077
Butter cutting machine, R. F. Stewart ..... 886,088
Button, detachable, L. Y. Smith ..... 885,879
Cabinet, L. E. Hudson ..... 886,000
Cake holder for conveyers, H. B. Ward .... 886,101
Calculating device, T. T. Crouch ..... 886,189
Cames, apparatus for packing, T. W. Morrell ..... 885,854
Can cleaning machine, J. M. C. Jones ..... 885,849
Candle extinguisher, self-acting, A. C. Findlay ..... 886,198
Capsule cleaning device, J. P. Remington .. 886,075
Car bolster, O. S. Pulliam ..... 886,069, 886,070
Car fender, Olschewski & Trensch ..... 885,780
Car underframe, W. McIntosh ..... 886,063
Cars, check lock for, H. S. Boucher ..... 885,907
Carbureter, A. W. Breiding ..... 885,832
Carbureter, S. G. Averell ..... 885,905
Carbureter, W. L. Wayrynen ..... 886,283
Carbureter, rapid fire, J. A. Speed ..... 886,265
Card rack, playing, H. de Joannis ..... 886,130
Card system, G. C. Anderson ..... 885,826
Carriage body, N. Gilbert ..... 885,744
Cementing apparatus, Phipps & Steele ..... 885,862
Chain, conveyer, J. T. Nicholson ..... 886,065
Chain, log conveyer, J. Schilleman ..... 885,959
Chair, C. W. Fischer ..... 885,843
Chair head rest, S. Wheeler ..... 886,102
Change-making machine, T. I. Potter ..... 886,307
Chemical reaction between materials, obtaining a violent, C. G. P. de Laval ... 885,766
Chromatrope, S. A. Hunt ..... 885,928
Chuck, D. A. Moore ..... 885,946
Chuck, reversible tapping, Dalton & Thompson ..... 885,914
Chute, sidewalk coal, T. F. Clark ..... 886,112
Clamp, J. R. Peirce ..... 885,949
Clarinet, F. W. Stahl ..... 885,880
Clasp, B. L. Green ..... 885,993
Clock attachment, electrical, O. P. Ragan .. 885,953
Clock, electrically operated, D. Sandretto .. 886,157
Clothes pin, W. A. Pugh ..... 886,245
Clutch, friction, F. Maxant ..... 885,938
Clutch mechanism, F. K. Lathrop ..... 886,004
Coaster, S. B. Brown ..... 885,977
Coat hanger, J. C. Dawson ..... 886,041
Cock, stop, W. W. Miller ..... 885,775
Coil spring, R. Gregg ..... 886,052
Collar support, E. Christie ..... 885,722
Composition of matter, H. L. Lilienthal .... 885,768
Composition of matter, S. Brown ..... 885,976
Compressor, rotary, C. C. Palmer ..... 885,783
Concrete mixing machine, R. J. Sellentine .. 886,018
Concrete structures, fitting for reinforced, G. M. Graham ..... 885,992
Conveyer belting and machine belting, manufacture of, F. Reddaway ..... 886,955
Conveying apparatus, T. S. Miller ..... 885,774
Conveying mechanism, C. W. Crosby ..... 885,730
Coop, C. B. Treat ..... 886,278
Corn, apparatus for tipping seed, B. G. Mease ..... 886,229
Corn husker, S. H. Minnis ..... 886,147
Corn husking implement, A. C. Baughman .. 886,033
Corn sheller feed regulator, W. J. Steckel .. 885,881
Corn tops, device for facilitating the tying of, D. W. Flynn ..... 886,048
Corset attachment, M. E. Risk ..... 886,076
Cotton chopper, automotic electric, Braguier & Thompson ..... 886,179
Cotton picker, I. A. Murchison ..... 886,236
Cotton separator, W. E. Rickey ..... 886,249
Counter, T. H. Mayo ..... 886,008
Coupling, O. N. Brandt ..... 886,180
Coupling head, J. M. Malloy ..... 886,007
Crucible compounds, manufacturing, C. Caspar ..... 886,111
Cruet, T. M. Mulkerins ..... 885,947
Crusher. See Rock crusher.
Cuff attachment for shirts and the like, hingeable, Bennett & Findlay ..... 885,971
Cultivator, W. A. Dewberry ..... 885,983
Cultivator, J. F. Deal ..... 886,190
Current turbo-generator, direct, D. A. Behrend ..... 886,035
Curtain ring, M. E. La Rue ..... 885,932
Cycle saddle support, Mamet & Hallot ..... 886,227
Damper regulator, H. M. Browne ..... 886,183
Dental structures, apparatus for forming, J. A. Lentz ..... 886,140
Dental vulcanizer, Korb & Hieber ..... 886,300
Derrick and car, collapsible wrecking, E. F. Terry ..... 885,803
Desk and cash holder, recording, J. E. Benjamin ..... 885,713
Desk, writing, C. Y. Haggard ..... 885,748
Diaphragm and making the same, H. Hirtz. 885,998
Discharge stem, C. Smith ..... 886,083
Dispensing stopper, H. G. Scott ..... 885,792
Display case, E. D. Obertrifter ..... 886,066
Display rack, E. B. Weston ..... 886,023
Door bolt, J. A. Roy ..... 885,866
Door check holder and buffer, duplex, I. P. Kibbe ..... 886,001
Door, grain, R. D. Stryker ..... 886,090
Door hanger, edgewise movable, S. U. Barr. 885,970
Door locking mechanism, roundhouse, J. U. Nettenstrom ..... 885,858
Door plate, W. Jones ..... 885,760
Door, revolving, H. W. Dyer ..... 886,317
Draft, automatic force or suction G. S. Stuart ..... 886,268
Drag, road, F. E. Ott ..... 886,067
Drawer, self-closing, V. A. De Canio ..... 886,192
Dredging apparatus, S. Lake ..... 885,930
Drilling machine, D. A. Moore ..... 885,945
Duplex tube, H. Emerson ..... 885,741
Dyeing and extracting machine, hosiery figure, C. S. Althouse ..... 885,709
Dyeing machine, J. Hussong, reissue ..... 12,788
Dyeing, preparation of the indigo-vat employed in, H. Chaumat ..... 885,978
Educational device, J. W. Bevans ..... 886,172
Egg opener, D. P. Stevens ..... 886,266
Egg turner, W. Bunker ..... 886,185
Electric apparatus, cooling system for, Randall & Gibson ..... 886,073
Electric contact shoes, support for, E. W. Farnham ..... 886,319
Electric controller, R. I. Wright ..... 885,967
Electric furnace, P. Girod ..... 885,745
Electric generators and motors, field adjusting device for, F. O. Ball ..... 886,109
Electric heaters, element for, Low & Hertzberg ..... 885,769
Electric power, contact post system for transmitting, G. E. Titcomb ..... 886,093
Electrical connection, H. R. Read ..... 885,864
Electrical distribution, J. S. Highfield ..... 885,847
Electrical distribution system, A. S. Hubbard ..... 885,754, 885,755
Elevator indicating system, C. E. Moore .... 885,941
Elevator safety device, A. Hollinger ..... 885,924
Elevator safety stop, Wisniewski & Matlak. 886,026
Elevators, safety flash-light apparatus for, C. E. Moore ..... 885,942
Embroidering machines, take-up hook for, C. N. Wheaton ..... 885,817
Engine indicator, J. W. Thompson ..... 886,021
Engine releasing gear, Schneider & Roesti. 885,870
Engine reversing mechanism, traction, J. C. Metcalf ..... 886,232
Engine tender, traction, M. Jorstad ..... 886,059
Engines, current distributing device for igniting explosive, H. de La Valette ..... 886,225
Engines, ignition for explosion, R. Varley .. 885,894
Engines, operating combustion, Winand & Neumann ..... 885,820
Engines, working expansion, F. Hildebrand. 886,054
Envelop fastener, E. B. Stimpson ..... 885,884
Excavator, C. C. Jacobs ..... 885,756, 885,757
Exerciser, W. Barrett ..... 886,032
Exercising apparatus for oarsmen, D. Scanlan ..... 885,871
Explosive, A. E. Charbonneaux ..... 886,038
Explosive engine, C. R. Bryant ..... 886,184
Extension table, F. J. Seng ..... 885,962
Eye shield, G. E. Henry ..... 886,209
Eyeglass guard, W. I. Dengler ..... 885,735
Eyeglass stud, D. D. Updegraff ..... 885,808
Eyeglasses, L. B. Becker ..... 885,829
Fare indicator for carriages, R. Picard ..... 886,244
Feed bag, G. Rodriguez ..... 886,252
Feed gage, E. L. Megill ..... 885,773
Feed mechanism, electrically controlled, B. M. W. Hanson ..... 886,294
Feed water regulator and alarm, W. D. Hodgson ..... 886,295
Feeding-off mechanism, W. A. Tompkins ... 886,277
Fence-maker's combination tool, J. E. Weyeneth ..... 885,816
Fender. See Car fender.
Fertilizer distributer, E. B. Hackburn, et al 886,207
Fiber from vegetable tissues, use of hot air in extracting, M. R. Kennedy ..... 885,851
Filing case, document, Ripson & Sampson .. 885,789
Filling attachment, E. N. Roth ..... 885,865
Firearm magazine, A. W. Savage ..... 885,868
Fish drying apparatus, J. Urquhart ..... 886,094
Floor, drying, Robinson & Steadman ..... 886,251
Flooring, S. W. Heaton ..... 885,751
Fluid-actuating apparatus, R. Conrader ..... 885,312
Flying machine, B. Guthrie ..... 886,122
Foundry separator, E. G. Pfau ..... 886,152
Funnel, J. P. Murtha ..... 886,237
Furnace. See Electric furnace.
Furnace, F. Gold ..... 886,205
Furnace, C. W. Smith ..... 886,261
Furnace charking apparatus, F. B. Goldey ... 885,920
Furnace door, A. Cottom ..... 885,727
Furnace door protector, H. J. Marx ..... 886,144
Furnace spout, smelting, D. H. Browne .... 886,286
Furniture, folding, W. Rabich ..... 886,072
Gaff hook, C. H. F. Kraft ..... 886,003
Garment hanger, W. De Frear ..... 886,042
Garment hanger, D. W. Custer ..... 886,116
Gas and steam engine, combination, M. S. Flaig ..... 886,199
Gas apparatus, E. H. Amet ..... 886,311
Gas burner, steam blast, G. S. Bennett .... 885,972
Gas engine, Griswold & Averell ..... 885,921
Gas fixture, C. Gerlach ..... 886,120
Gas generator, W. Tures ..... 886,209
Gas generator, hydrocarbon, A. D. Sumner .. 885,886
Gas lighting mechanism, automatic, N. H. Shaw ..... 885,795
Gas, producing, E. H. Amet ..... 885,903
Gas-producing apparatus, E. H. Amet ..... 885,904
Gas, recovering ammonia and heating air in the manufacture of producer, Crossley & Rigby ..... 885,980
Gas, treating, J. S. McIlhenny ..... 885,857
Gas under uniform pressure, generating and delivering, W. C. Finck ..... 886,289
Gas washer, F. H. Moyer ..... 886,009, 886,304
Gear for motor vehicles, transmission, L. H. Dyer ..... 885,986
Gear, variable speed, J. E. Barker ..... 885,710
Glass, method of and apparatus for drawing sheets of, H. J. Walter ..... 885,896
Glass mold, W. Millstein ..... 886,146
Glasses in place, suction device for securing, J. J. Tanzey ..... 886,273
Glove, cotton picking, J. A. Layton ..... 885,767
Grain screen, G. H. Rechtenbach ..... 886,247

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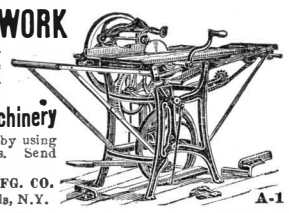

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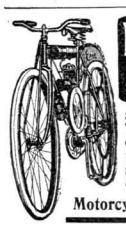

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| | |
|---|---|
| Grain separator, R. J. Owens | 886,306 |
| Graphophone needle, W. Fitzpatrick | 885,989 |
| Graphophone, phonograph, and the like, J. O. Hirschfelder | 886,056 |
| Grate, H. W. Whelan | 885,898 |
| Grinding or mixing mill, edge runner, C. B. Cole | 885,723 |
| Grinding roll, L. C. Wales | 886,099 |
| Gun cleaning rod, B. E. Clement | 886,188 |
| Gun stock, R. H. Julien | 886,131 |
| Hame, K. O. Rue | 886,156 |
| Handkerchief receptacle, J. Cave | 885,721 |
| Harness, A. M. Craig | 885,911 |
| Harvester, flax, I. W. Weeks | 885,897 |
| Harvester reel, J. T. Brett | 885,833 |
| Harvesting machine, cotton, G. H. Zempter | 886,335 |
| Hat curling machine, Lyman & Ives | 886,142 |
| Hat fastener, comb, Goodale & Stacy | 885,746 |
| Hat packing case, A. I. Coe | 885,979 |
| Hay press, L. B. Wygant | 885,823 |
| Heated chamber, fluid, C. E. Ord | 885,781 |
| Heating and ventilating apparatus, E. F. Osborne | 886,325 |
| Heating apparatus, portable hot fluid, H. T. Offterdinger | 886,305 |
| Heating system, T. F. Scollard | 886,079 |
| Heel seat trimmer for patent leather, D. H. Hadsell | 886,291 |
| Hitching device, A. Wagner | 886,166 |
| Hoe, garden, T. Grassbaw | 886,203 |
| Hog ring, P. A. Swanson | 886,162 |
| Hoist controlling system, Shover & Eastwood | 885,961 |
| Hoisting apparatus, H. P. Clough | 886,113 |
| Hoisting bucket, C. Chase | 885,910 |
| Horse power, J. S. Tuttle | 885,892 |
| Hose, chemical mixing attachment for, B. F. Wooding | 885,902 |
| Hose nozzle, S. Suzuki | 886,272 |
| Hose sections, apparatus for capping, S. J. Sill | 885,797 |
| Hosiery drying boards, cushioning protector for, J. J. Crimlisk | 885,728 |
| Hydrocarbon burner, R. H. White | 886,103 |
| Ice creeper, J. A. E. Anderson | 885,827 |
| Igniter, electric, J. N. Lansinger | 886,138 |
| Incubator signaling device, G. Mucke | 886,148 |
| Ingots, manufacture of compound, W. H. Connell | 885,839 |
| Ink well, A. E. Swan | 886,161 |
| Insulated canopy collar, T. H. Bullock, Jr. | 885,836 |
| Insulation, transformer coil, J. E. Mateer | 885,771 |
| Internal combustion engine, C. J. Mundhenk | 886,235 |
| Internal combustion engine, rotating, E. L. Vervoort | 886,279 |
| Interrupter, A. R. Luschka | 886,141 |
| Ironing machine, J. S. Langworthy | 885,765 |
| Ironing machine, W. E. Andree | 886,028 |
| Jar closure, H. E. Jolly | 886,218 |
| Jars and the like, closure for milk, F. K. Plympton | 886,014 |
| Jarring device, E. E. Messmore | 886,231 |
| Jewel and pivot gage, F. R. Coats | 885,838 |
| Jewel coupling machine, J. Wennstrom | 886,310 |
| Joint. See Rail joint. | |
| Keyless lock for traveling bags, etc., J. Kruse | 886,136 |
| Knitted fabric, R. W. Scott | 885,793, 885,794 |
| Label for cotton bales, T. F. Steele | 886,086 |
| Laboratory apparatus, physical, L. E. Knott | 885,763 |
| Lacing hook setting machine, W. F. Fraser | 885,919 |
| Ladder, J. Waters | 886,282 |
| Lamp attachment, W. D. Markham | 886,323 |
| Lamp, electric arc, H. Beck | 885,906 |
| Lamp, gasolene, I. T. Smith | 885,799 |
| Lamp, incandescent gas, H. Sussmann | 886,271 |
| Lamp, miner's, R. L. Graves | 886,204 |
| Lamp receptacles, means for supporting, J. S. Stewart | 886,267 |
| Lamp socket, W. C. Tregoning | 885,890 |
| Lamp starting device, mercury, C. P. Steinmetz | 885,882 |
| Latch, door, W. F. Marten | 886,143 |
| Lens grinding and polishing machine, W. F. Hoffman | 886,212 |
| Letter, sign, G. L. Mason | 885,936 |
| Level attachment, D. H. Southward | 886,333 |
| Level, spirit, M. Kleinbauer | 885,762 |
| Lever, selective, Warner & Jones | 885,814 |
| Life-belt apparatus, J. Focketyn | 885,918 |
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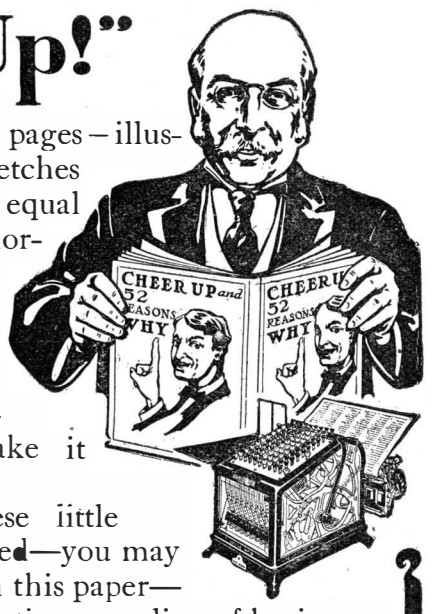


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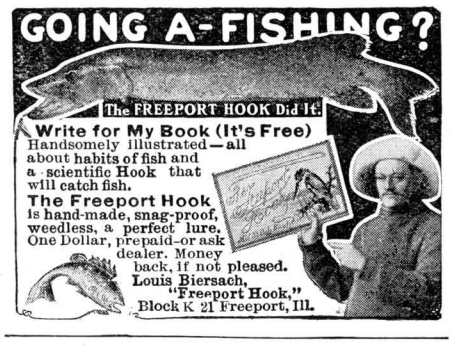


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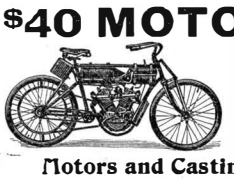

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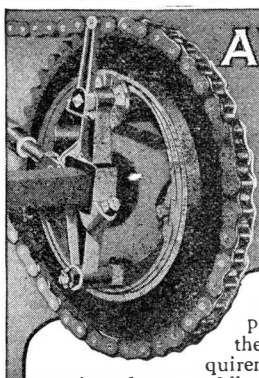

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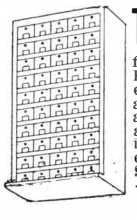

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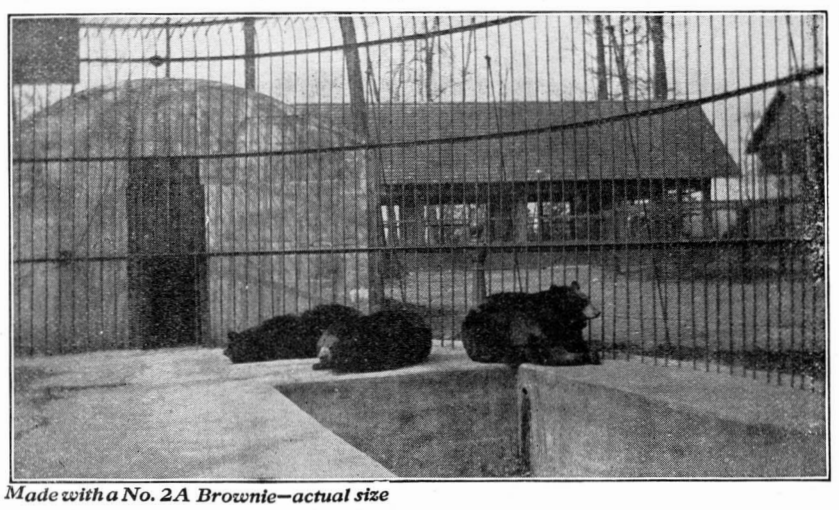

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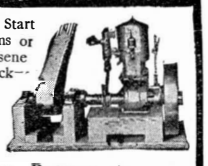

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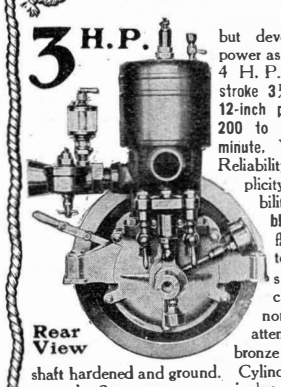

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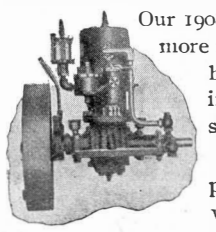

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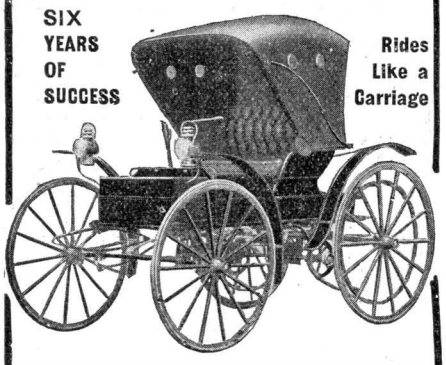

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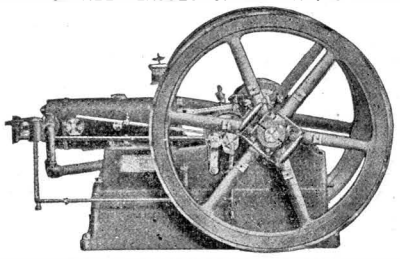

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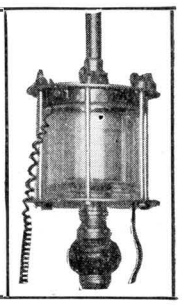

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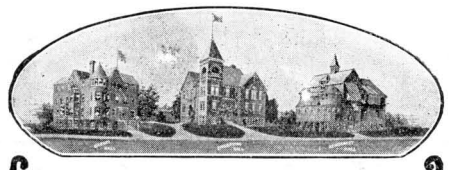

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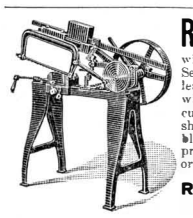

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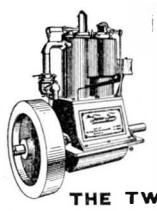

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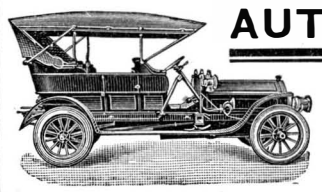

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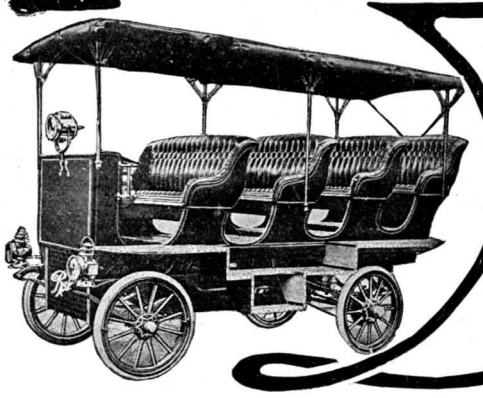

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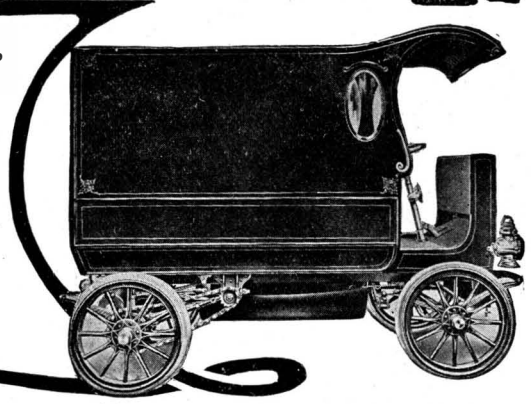

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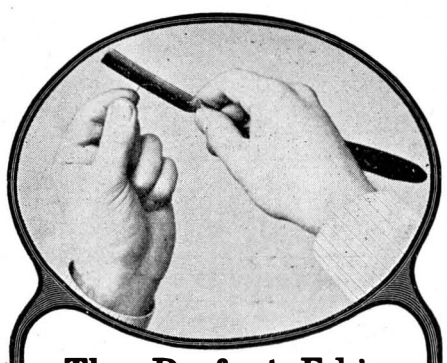

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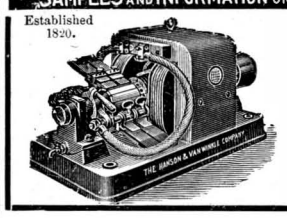


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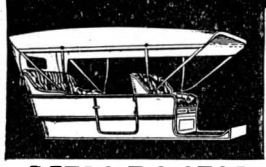

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